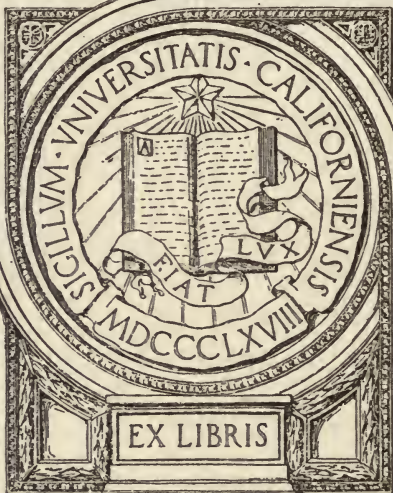


LIVE STOCK AND FARM MECHANICS



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LIVE STOCK AND FARM MECHANICS



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LIVE STOCK AND FARM MECHANICS

BY

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PREFACE

NEW subject matter is constantly being added to Agriculture. Since so many boys and girls go no farther than the grades, and since Agriculture should function in the lives of these boys and girls, it has been the pleasure of the author to bring much of this new material to them in this book.

Important subject matter relating to the use of concrete, to road construction, rope tying, farm buildings, farm home conveniences, farm machinery, boys' and girls' clubs, efficient marketing and factors essential to success in farming, and the new material relating to live stock and the live stock situation of the world have been treated in this book.

The laboratory exercises and home projects, suggested at the close of each chapter, constitute a very important part of the course. These laboratory exercises should be performed and written up in a regularly kept notebook. Each exercise should be written out under the following headings :

1. Object
2. Materials used
3. Procedure
4. Conclusion

Some exercises may be followed with application questions.

The chapter dealing with boys' and girls' clubs should be read early in the course, so that club work may be begun at the proper time.

Throughout the entire study of Agriculture there are some things which should be made. Among these are the follow-

ing: self-feeders, miniature barns for various farm animals, egg nests, doors, gates, and various things made of concrete.

Whole literary programs may occasionally be given on topics relating to Agriculture. The members of the class studying Agriculture should debate some question relating to this subject at least once a month. At the close of this text there are twenty suggested topics for debate. It is surprising how children will improve in debating through three or four months' practice.

Credit is due Miss Lillian Brucher, head of the Home Economics Department of the Southeast Missouri State Teachers College, Cape Girardeau, Missouri, for writing the chapter on farm home conveniences; Prof. R. H. Emberson, in charge of boys' and girls' clubs, University of Missouri, for writing the chapter on boys' and girls' club work; Prof. Jephtha Riggs, Professor of English of the Southeast Missouri State Teachers College, Cape Girardeau, Missouri, for reading the entire manuscript; and to President Joseph A. Serena of the Southeast Missouri State Teachers College for many valuable suggestions given.

Further acknowledgments are due to the Portland Cement Company for permission to use Figures 90, 91, and 93; to the South Dakota Station for Figure 142; to the Iowa Experiment Station for Figures 149 and 150; and to the United States Department of Agriculture for Figures 1, 6, 92, 96, and 98; and to McGraw-Hill Publishing Company for illustrations in Chapter XV.

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February 2, 1922.

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PART ONE
LIVE STOCK

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LIVE STOCK AND FARM MECHANICS

CHAPTER I

ADVANTAGES OF ANIMAL HUSBANDRY

THE virgin soils of our land have been exploited and robbed of their plant nutrients to such an extent that Conservation of Soil Fertility Congresses, our Agricultural Colleges and Experiment Stations, the United States Government itself, and all informed farmers have turned their thoughts and efforts to farm practices that will prevent the further exhaustion of our soils. One purpose of this chapter is to convey the notion that animal husbandry is a way of maintaining soil fertility. There are also many other farm practices which help to conserve our soils, increase our crop yields, and tend to make our people happy and prosperous, and are conducive to permanent agriculture.

The main purpose of this chapter is to indicate how animals tend to make American agriculture more permanent. Some of the benefits which may accrue from animal husbandry farming and which make our agriculture more permanent, are the following:

1. Animals aid in maintaining the fertility of the soil.
2. Stock farming tends to a better system of crop rotation.
3. Feeds that otherwise would be partially wasted are utilized.
4. Animals manufacture raw materials into a marketable product.
5. Stock farming gives more constant employment.
6. Stock farming often increases the profits.
7. The leading nations in their periods of greatest prosperity have been producers of animals.

8. Animal husbandry tends toward a progressive agriculture and more intelligent farming.

These topics will be discussed in the order named.

Animals aid in maintaining the fertility of the soil. — Every schoolboy or schoolgirl or farmer who reads this knows that constant cropping and selling the crops tend to make the soil less productive from year to year. Grain and hay crops, if sold from the farm, remove plant foods as follows :

CROP	FERTILIZING CONSTITUENTS IN ONE TON			FERTILITY VALUE PER TON	MANURIAL VALUE PER TON
	Nitrogen, Pounds	Phosphoric Acid, Pounds	Potash, Pounds		
Dent corn (grain)	32.4	13.8	8.0	\$ 6.85	\$ 5.48
Wheat	39.6	17.2	10.6	8.83	6.74
Oats	39.6	16.2	11.2	8.42	6.74
Timothy hay . .	19.9	6.2	27.2	5.20	4.16
Red clover hay .	41.0	7.8	32.6	9.36	7.49
Oat straw . . .	11.6	4.2	30.0	3.78	3.02
Corn silage . .	6.8	3.2	8.8	1.81	1.45
Cottonseed meal, choice	141.2	53.4	36.2	29.63	23.70

From this table it will be observed that if two thousand pounds of dent corn be taken from a farm, 32.4 pounds of nitrogen, 13.8 pounds of phosphoric acid, and 8.0 pounds of potash are taken from the soil. These ingredients sell at an average of 18.0, 4.5, and 5.0 cents per pound, respectively, when purchased in commercial fertilizers. At this rate a ton of corn removes \$6.85 worth of soil fertility. It has been found by experimentation that, when feed is fed the average animal, 80 per cent of the food nutrients in the feed are voided in the manurial product. The manurial value given in the last column of the above table is in each case 80 per cent of the fertility value of the food named.

The manurial value of feed stuffs varies, as the table indicates, with the composition of feeding stuffs. The table deserves close study.

When animals or animal products are taken from the farm, much less fertility is removed; and especially is this true when the fertility value of the feed out of which the finished product is made is compared to the animal product sold. This particular point is too difficult to present here. However, the fertilizing constituents of a few animal products are as follows:

	FERTILIZING CONSTITUENTS PER TON			FERTILITY VALUE PER TON	MANURIAL VALUE PER TON
	Nitrogen, Pounds	Phosphoric Acid, Pounds	Potash, Pounds		
Fat pig	35.4	13.0	2.8	\$7.10	\$1.94
Fat ox	46.6	31.0	2.6	9.96	
Milk	11.6	4.0	3.4	2.43	
Butter	2.4	0.8	0.8	.51	

Compare this table with the preceding one. A ton of pigs remove \$7.10 worth of fertility and dent corn \$6.85 of fertility. When the fact is known that it requires from five to six tons of corn to make one ton of pork, and that 80 per cent of its fertilizing value is returned to the soil, we may conclude that animal husbandry tends to maintain soil fertility. It has been summed up thus: "A farmer selling hay sells in the form of fertilizer value, one-half as much as he receives; if he sells pork, he receives twenty times as much for it as the value of the fertilizers contained in it; if milk, forty times; and if butter, one thousand times."¹

See the following chapters, and especially the chapters on dairy cattle, swine production, and sheep production, on the relation of animal husbandry to the maintenance of soil fertility.

¹ Burkett; "Feeding Farm Animals."

Stock farming tends to a better system of crop rotation. — Where grain farming is practiced, only one or two crops are usually produced. Such a practice caused our soils to become less productive. The United States Yearbooks clearly indicate that the acreage yields of the leading American farm crops became less and less up to about 1900, and from then on our acreage yields have been gradually increasing. The increase in crop yields the last fifteen years has been due to better methods of seed selection, seed testing, better methods of cultivation, rotation of crops, and other modern farm practices. The decrease in acreage yields previous to 1900 was due to a system of grain farming in which only one or two kinds of crops were produced, sold off the farm, and nothing returned.

In any kind of stock production a liberal use of pasture crops makes for cheap gains. The liberal use of the leguminous crops in pork, mutton, beef, and milk production, taking one year with another, cheapens production. Many farmers are beginning to realize that it is expensive to import feeds. It is for this reason that farmers are studying and planning how they may grow crops, so that they will have a well-balanced feed, and at the same time not deplete the soil. The solution of this problem is a proper balance of grain crops to furnish the carbohydrate material, and the growing of clovers, alfalfa, soybeans, and cowpeas, which furnish the protein of the feed. The latter crops tend to balance the grain ration, and at the same time restore nitrogen to the soil.

Feeds that otherwise would be partially wasted are utilized.—The grass that grows along streams, fences, and roadways would be lost if not consumed by grazing animals. Much land that cannot be tilled profitably is used as grazing land. Corn fields, where the ears have been gathered, furnish a great deal of roughness for a month or more to cattle, sheep, and horses.

Straw stacks and the grasses and weeds in stubble fields will produce a fine product. The screenings at threshing time furnish excellent feed for poultry. A small flock of sheep is kept on many farms simply as plant scavengers. The large quantity of weeds they consume is transformed into wool and mutton. Goats, in many sections, help greatly in ridding pastures of sprouts and weeds. There are very few sprouts goats will not eat. Their services in renovating pastures may often be worth from 50 cents to \$1 per acre. Turkeys roam over pastures and fields, eating grasshoppers and other insects. The dairy, the garden, the orchard, the field, and the roadside provide feeds which, if utilized, may bring a fair income and change the farm operation from a losing one to a profitable one. The small odds and ends utilized by animals may mean the difference between success and failure, for to a considerable extent the profits thus secured are almost pure profits.

Animals manufacture raw materials into a marketable product. — The animal is a manufacturer. Not only are the cheap feed stuffs thus utilized, but the corn, silage, hays, bran, cottonseed meal, and various other crops and their by-products are used by animals, and converted into salable products. The following facts in a general way indicate the manufacturing capacity of various farm animals:

ANIMAL	FEED	AMOUNT OF PRODUCT PRODUCED	APPROXIMATE VALUE
Dairy cow . . .	Corn silage 30 lb., alfalfa 10 lb., corn 6 lb., bran 2 lb., water 75 lb.	25 lb. milk, test 4.0% or one pound but- terfat	35 cents
Swine	5-6 lb. corn	One pound pork	7½ cents
Sheep	8-9 lb. corn	One pound mutton	7½ cents
Steer	10-11 lb. corn	One pound beef	7½ cents

It should not be concluded from this table that one kind of animal produces meat more economically than others. The table is not recorded for that purpose. The table simply indicates that animals are manufacturers. When the fact is recalled that sheep consume feeds that hogs will not use, the conclusion may be drawn that sheep are the most profitable of all the animals, under certain conditions.

The raw products cannot always be shipped to market profitably. For illustration, the dairy cow utilizes about 48 pounds of feed stuffs to manufacture one pound of butter. The raw materials have a low selling value per pound, but a pound of butter may sell for 35 cents per pound. The freight charges in transporting the raw materials would be extremely costly in proportion to the value of the product sent; while the finished product can be shipped at a comparatively low cost. Animals hold an important relation to permanent agriculture because they are manufacturers.

Stock farming gives more constant employment. — It tends to distribute labor. In grain farming all the labor is demanded in a short period. Stock farming causes a diversity of crops to be grown, and this of itself causes a more even distribution of labor, and stock always need attention. All the labor in connection with timothy hay comes in about one month, or one twelfth of the entire year. Generally speaking, men get paid according to the time they work; one twelfth time, one twelfth pay. Read the chapter on farm labor. Our agriculture will not be nearly so permanent until the labor on the farm becomes more constant. Stock farming tends to give constant employment.

Stock farming often increases the profits. — This is especially true where young stock, stock of the proper conformation, quality, and disposition, are used, and where the farmer knows how to secure economic gains from them. Bankers seldom turn

down a loan on young growing stock, especially if it is of the right kind.

The leading nations in their periods of greatest prosperity have been producers of animals. — The nations which are the leading and most progressive have been and are consumers of large quantities of meat and animal products. They likewise



FIG. 1. — The striking contrast here shown is the best argument for investing feed and care where they will pay best.

are consumers of vegetable products. Those nations which have a low state of civilization consume either meats alone or vegetable products alone. The barbarian uses either an entire meat diet or an entire grain diet. The nations that consume either exclusively are usually in a low state of civilization. We need to refer only to China and Russia to illustrate this point. The Romans, Greeks, and Hebrews consumed meat to a considerable extent. From the first two races we received much

in the way of laws and literature; from the Hebrews we received the Old and the New Testament, and Christianity. The Teutonic race, comprising the peoples of England, Germany, and America, contributed the democratic system of government, — all are and were liberal meat eaters.

Even the states of the United States that are the most progressive, as shown by their roads, schools, farm implements, and stock, are greater producers of animals than are those states more backward along these lines. On this point in connection with dairying, Professor Eckles states in "Dairy Cattle and Milk Production": "If a list were prepared of our own states, selecting those where the average soil fertility is best conserved, the most intelligence found among the people, it would be a list of the leading dairy states." The American people are consumers of greater quantities of animal products per capita than are the people of any other nation. And where may a superior people, both physically and mentally, be found? Well-developed men and women, physically and mentally, are necessary for a permanent agriculture.

Animal husbandry tends toward a more progressive agriculture and more intelligent farming. — One of the simplest forms of agriculture was that practiced by the wandering shepherds described in the Bible. The shepherds drove their flocks to new pastures. Scarcely any skill was required. The cowboys of the West in pioneer days needed little intelligence and, in a way, exemplify simple agriculture. Tilling a one-kind crop from year to year requires greater intelligence, because the use of tools and implements makes it a little more complex. Growing two kinds of crops adds complexity to the operation, because the methods of soil preparation, seeding, cultivating, harvesting, and kinds of tools used vary somewhat with the two crops grown. Many farmers in the "corn belt" know how to grow corn but do

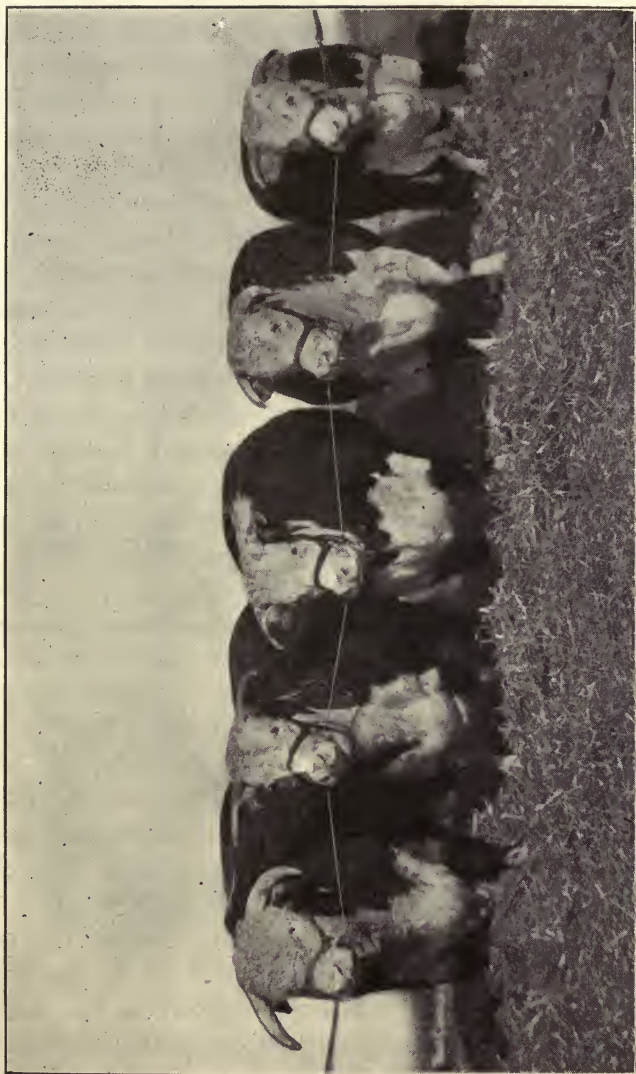


FIG. 2. — A fine group of Hereford cattle. Such cattle are worth much to any state.

not understand how to grow alfalfa. A third kind of farming that requires still more skill and intelligence is a system of grain farming, where a rotation of crops is practiced and five or six different crops are raised. Rotating crops, so that the soil fertility will be maintained, so that insects of various crops are combated, so that labor is well distributed, and selling each crop at such a season that the most is realized, is a difficult system of farming indeed. But a fourth system of farming that is still more complex is one in which all the good points of the third system prevail, and in addition several different kinds of animals are produced. In animal husbandry farming, housing, feeding, care, and management, combating disease and enemies, selecting the types and kinds of animals that will prove profitable, — all of these points in connection with every kind of animal handled add greatly to the complexity of the farm operations. Animal production requires additional skill for its successful operation.

Animal husbandry causes men to become more sympathetic. The man who hammers steel from day to day deals with an inanimate thing. The producer of plants notices the response of the soil and the plant to his kind treatment. But the man who handles sheep, horses, cattle, — the shepherd, the horseman, the cattleman, — notes the instinctive reaction of the animal kindly treated, until the mental attitude of both animal and man are greatly improved. The dairyman has long since learned that kind treatment brings economic returns. The shepherd well knows that his voice is known by every sheep. The horseman fully realizes that if he commands his horse intelligently, the horse will respond in like manner. This intelligent, harmonious, responsive spirit between man and animal are prerequisites to permanent successful agriculture.

Summary. — Animal husbandry farming helps in maintaining the fertility of the soil, tends to a better system of crop rotation, utilizes feeds that otherwise would be partially wasted, manufactures raw materials into a marketable product, gives more constant employment, and often increases profits. The leading nations have been and are producers and consumers of meat and meat products, and animal husbandry promotes a progressive and intelligent agriculture. Animal husbandry farming sustains important relations to the permanency of our American agriculture. Therefore, it behooves the schools, the farmers, and the consumers to study the close relation of animal husbandry to permanent agriculture, in order that here as elsewhere the old saying that "education is the safeguard of our nation" may be fully realized.

LABORATORY EXERCISES AND HOME PROJECTS

1. Are there any farms in your locality that do not readily respond to the husbandman? If there are, write in three paragraphs three reasons why the soil does not respond readily. Make three recommendations you would suggest to make the soil more responsive. These three recommendations should be written in choice English and in three well-formed paragraphs.
2. Name ten products that would be waste products which may be utilized either by swine, beef cattle, sheep, or poultry.
3. Do you know of any field, garden, orchard, or pasture in which insects, grass, weeds, sprouts, or other plants are found which may be well utilized by some farm animal? What suggestions have you to offer regarding their utilization?

CHAPTER II

IMPROVEMENT OF FARM ANIMALS

Why improve farm animals? — Horses, beef and dairy cattle, hogs, sheep, and poultry have already been greatly improved. And the average person would hardly know what to suggest to improve further the best specimens of these various animals; but the expert breeder can see how further improvement can be made. Of course we all know that the animals found on the average farm can be much improved.

Why improve farm animals? First, because animals with a good conformation produce more cheaply than do those without. Some may say that the razorback will produce meat as cheaply as do the most improved breeds, but such is not the case. Some may still think that the Texas Longhorn will produce meat more cheaply than does the best Shorthorn steer. Again there are those who say that the native scrub cow will produce as much milk as the best Jersey; but no scrub ever has done so. No one has ever heard of a scrub making a really good record. The records of scrubs are not known and never printed. Some think that the assassins of our martyred presidents should never be honored by being named in history. Likewise the names of scrub animals are ordinarily never mentioned, because their records are not worthy of mention.

Grading up live stock. — The easiest and cheapest way to improve ordinary live stock is to grade them up. This is done by the use of a pure bred sire. In grading up, if the first offspring has 50 per cent purity of blood, the second will have 75 per cent,

the third 87.5 per cent, and so on. A high-grade animal has 75 per cent or more of the blood of a definite breed in its veins. A crossbred animal is the progeny of two different breeds of animals. Thus we may have a Holstein-Jersey cross.

Pure breeds. — Pure bred animals have 100 per cent of the blood of a definite breed. They have no blood or other characteristics from any other source. Not all pure bred animals are perfect, — in fact probably none are perfect, — but many of them are 85 to 95 per cent perfect; while low-grade animals are much lower in the scale of perfection. The best qualities that farm animals now possess come from the blood of pure breeds.

Registered animals are pure bred animals whose pedigrees are recorded in the herd book of that breed of farm animals. A pedigree gives a brief biography of the ancestors of a given animal for several generations. On page 17 is a pedigree of Hambletonian 10. Many pedigrees give more data than this pedigree.

There are two terms, indicative of breeding or breeding and performance in horses, that should be explained here because the student constantly meets them in reading and study. They are the expressions, "thoroughbred" and "standardbred."

Pure breeding in horses is indicated as thoroughbred. This term denotes the purest breed of horses, except the Oriental from which they are derived. They have been bred for two and one half centuries with running speed as the only consideration. They were the first for which pedigree records were kept and a stud book established. The term standardbred is applied to horses bred from a composite foundation in which the thoroughbred top cross figured most conspicuously, the base consisting of commonbred mares with well-developed trotting ability. The American road driver is largely responsible for the development of the standardbred. Performance rather than breeding has been the standard.

What are the advantages of good high-grade or good pure bred animals?—1. They will transmit their qualities or characteristics without great chance of variation. In other words, "like begets like." The new generation is like the preceding one, and the one before, and the one before that. The daddy was like his daddy, and his daddy was like his daddy, etc., — for many generations back. The mammy was like her mammy, and her mammy was like her mammy, etc., for many generations back. The daddies and the mummies belonged to the same breed for hundreds of years. If all the daddies and mummies were alike, why should not the offspring also possess the same characteristics and qualities?

2. Pure bred animals are adapted to a specific purpose. The bird dog is good for hunting birds; but the rat terrier hunts and digs for rats all day long. It is fine that there are horses for pulling loads, horses to ride, and horses for the race. It is fine that there are cows that will give milk for many persons, and others that will produce a lot of meat with a few pounds of feed. This study of pure bred animals being adapted to a specific purpose can be continued indefinitely.

3. Pure bred animals produce more with a given amount of feed than do scrubs. Pure bred hogs not only will gain more than scrubs with a given amount of feed but also will dress out more meat. No one has ever heard of a scrub pig, a scrub cow, or a scrub chicken making a noteworthy record; but many noteworthy records have been made by pure bred.

4. Pure bred animals are more attractive, and more pride is taken in them. The greater the care and attention given them, the better the results.

5. Pure bred animals sell for more money than do scrubs or grades. It is well known that animals which are uniform in size and color sell for more than do those which are not uniform.

PEDIGREE OF HAMBLETONIAN 10

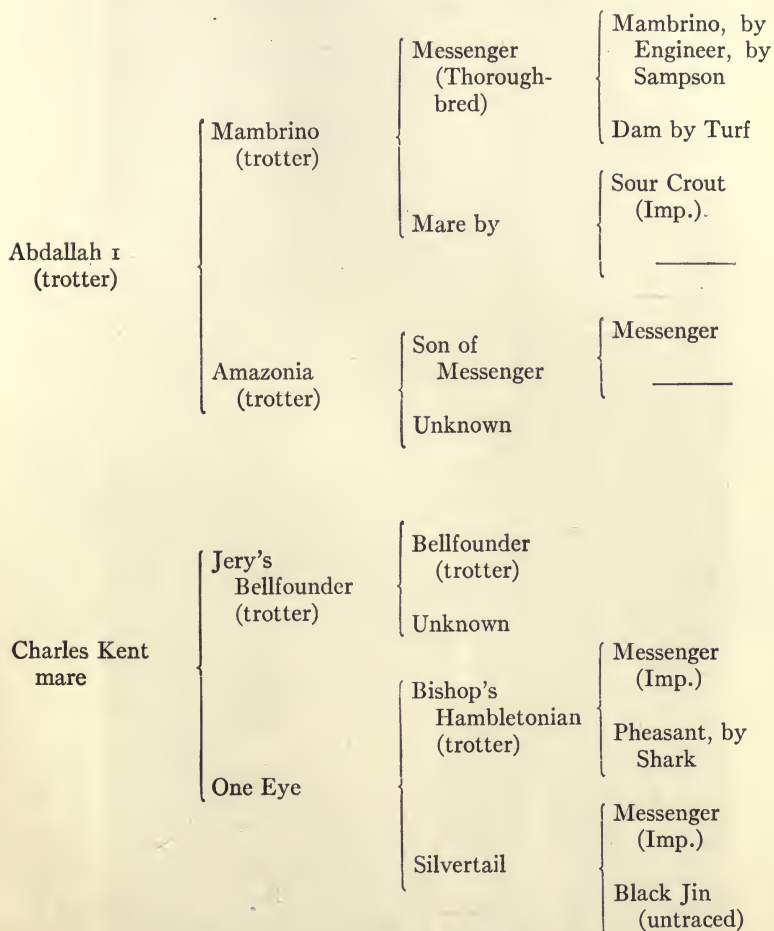




FIG. 3.— A group of uniform Shropshire sheep. The next generation will likely be like them for "like begets like."

This is true in the ordinary market ; and when animals are sold for breeding purposes, registered animals with good pedigrees sell much more easily and at better prices than others.

For all of the reasons stated, farmers can well afford, if they do not possess pure breds, to use at least pure bred sires. For in so doing they will ordinarily reduce the cost of production.



FIG. 4.—Note the attractiveness of this flock of White Plymouth Rocks. They are quite uniform in shape and color.

The lines of live stock improvement.—Animals are improved along various lines. A few of these will be studied :

1. Chickens are constantly being improved so that they will produce more eggs. The jungle fowl produced in a year 10 or 12 small eggs, which weighed in the aggregate from 4 to 8 ounces ; but the average hen now produces about 5 dozen eggs, which weigh about 120 ounces ; and there are many hens that produce over 200 eggs, which have a total weight of over 300 ounces. The chapter on poultry explains how the high producers may be

detected. It is important that we know how to tell the good producer from the poor producer. A poor layer eats much feed, but returns little or nothing for the work, shelter, and feed man so kindly provides for her.

2. The dairy cow is improved so that she will yield more milk with a given amount of feed. There are many cows that do not pay for their keep. A cow producing 200 pounds of butterfat will probably pay her board bill. Of course, she will help to keep some one alive. But the farmer must have more than



Courtesy Ginn and Co.

FIG. 5. — A good producing cow produces enough milk to nourish a dozen to fifteen calves. The native cattle gave about enough milk to nourish one small calf.

just a bare living. He must produce a surplus and lay it up for a rainy day. The use of good sires helps to increase the milking qualities of the next generation. For illustration, at the University of Missouri they had a bull named Missouri Rioter 3d. Several cows bred to him had 14 lactation periods and produced on the average 4715 pounds of milk. The daughters of these cows had 15 lactation periods and produced an average of 8005 pounds of milk in each lactation period. This was moving upward.

Why should not the dairyman select bulls which come from cows and sires that have real producing ability? To improve

the dairy herd with a good sire is the easiest, cheapest, and quickest way to build up the herd.

3. Wool production can also be increased. Sometimes wool is so cheap that it is not desirable to increase the output. But if it is desirable to increase the production of wool, it can be done by the use of a ram having wool-transmitting qualities. Laramie, a Rambouillet ram, owned by the Agricultural College of Still-



FIG. 6. — A litter of ten husky pigs. Large litters lower the cost of production.

water, Oklahoma, was sheared at the end of 15 months and his fleece weighed 46 pounds. A good wool is kinky, and its hairs are fine and of medium length. These qualities can be secured by breeding and selection.

4. The meat-producing ability of animals can often be improved, and thereby the cost of production may be reduced. Accordingly, at the University of Missouri they found in an experiment the following: "Seventeen lambs from a pure bred sire and Western ewes weighed on an average 63 pounds when

three months old and sold for \$7.35 per hundredweight; while 17 lambs sired by a scrub ram weighed 56 pounds when four months old and sold for \$4.50 per hundredweight. Besides this the good lambs required less feed to produce one hundred pounds of gain.

“There are a great many hogs, sheep, fowls, and beef cattle that can be improved in their meat-producing ability by the use of a well-conformed, good, pure bred sire. Here is one of the most fertile fields for making money. Good breeding pays. Poor breeding must be overcome by an additional expenditure for feed.”

5. Speed is the all important thing in the horses used on the race course. Their form and function go hand in hand. They must have such a form that they can excel in speed. Of course, they must have endurance and such a spirit and disposition that they will win in the race.

6. In draft horses, weight, conformation, symmetry, quality, capacity, temperament, style, and walking ability are emphasized. To secure all of these qualities will require the best thought and judgment of the most capable horsemen of the entire country.

7. Often animals are not prolific; that is, they do not produce sufficient offspring. Large litters of pigs reduce the cost of pork production. Small litters increase the cost of pork production. Breeds of hogs that will persistently produce litters of only two or three pigs must soon give way to a breed that is prolific. The Poland China breed of hogs several years ago almost became extinct because it lacked prolificacy. The breed was changed and to-day it ranks very high in popularity. Within reasonable limits man can by selection increase prolificacy in animals. This is an important line of animal improvement. Sheep and poultry, as well as all other farm animals, can be and must be improved along this line.

A SUMMARY OF THE TEN YEARS' RECORDS MADE BY SOPHIE 19TH

POUNDS MILK ONE YEAR	POUNDS FAT ONE YEAR	AGE
12,185.0	683.20	15 8
10,360.9	566.56	14 6
8,688.2	507.26	13 0
15,958.2	847.87	11 9
11,915.4	680.49	9 7
17,557.8	999.10	7 11
15,099.4	931.90	6 7
14,373.2	854.90	4 11
9,924.8	570.80	3 8
7,050.2	395.90	2 2
123,113.1	7,037.98	

8. Constitution, vitality, endurance, and long years of service are important items to remember in improving live stock. It costs money to raise a colt or a calf. To raise a colt or a calf which lacks vitality to live a reasonable number of years is very expensive. The highest record of achievement for an animal is to live long and produce much. Sophie 19th of the Hood Farm has the foregoing record to her credit. It shows constitution and longevity, and is indeed a long-distance record. Similar illustrations could be given for other breeds of cows.

Thus Sophie 19th produced 123,113 pounds of milk and 7038 pounds of butterfat. The butterfat test of the milk is secured by dividing the butterfat by the milk produced; that is, in this case 7038 divided by 123,113, or 5.72 per cent. This rule holds for determining the test of milk under all conditions.

9. Form in animals attracts the eye of the most disinterested person. The most beautiful lines and figures in nature are found in animal life. It is wonderful that man has so perfected animal

form, yet there is much to be done in the average herd before perfection is attained. The breeder must have the picture of the perfect form in his mind. Then he begins to combine, mold, and form animal life so that the ideal is more nearly approached. This often requires a lifetime, for it is difficult to secure the perfect type.

10. Color and color markings and how to secure and maintain these markings engender more interest than almost anything else in animal improvement. Every breed of farm animal has a most desirable color, and to secure and maintain that color is very difficult and costs much energy, time, money, and anxiety. Uniformity of color in a herd almost guarantees that other qualities are uniform and similar. When the color cannot be controlled, the other qualities cannot be controlled either. It is interesting to study the color and color markings as set forth by the different breed associations. The study of the 132 varieties of fowls described and discussed in "The Standard of Perfection" is both interesting and informational.

Community coöperation in the improvement of live stock. — Often an entire neighborhood gets together on an important movement; and if a real spirit of coöperation exists, success is likely to be the result. Community coöperation may show itself in boys' pig clubs, girls' poultry clubs, and cow clubs. These very organizations become the basis for organizations which later mean so much in community development.

A good sire will improve a breed of live stock, whereas a poor sire may cause deterioration in the live stock in an entire community. Some counties are noted throughout the United States for a specific breed of animals; and for the fine stock they have. These communities usually have a good sale for their surplus breeding stock. This results in good money returns and in better homes, schools, and churches.

Summary. — The lines of live stock improvement are greater egg production, greater milk production, greater wool production, greater prolificacy, greater meat production, greater endurance and vitality, greater speed, greater weight, a better form and more action in draft horses, better color, and general improvement so that the animals are more efficient for the particular purposes for which they are produced.

Pure bred animals are more efficient than are scrubs and grades. Pure bred animals have some very definite advantages. These advantages are: they transmit their qualities with greater certainty; they are adapted to a specific purpose; they produce more with a given amount of feed; they are more attractive; and they sell for more money. Often entire localities become noted for the fine live stock they have, and the best results are frequently secured through community coöperation.

LABORATORY EXERCISES AND HOME PROJECTS

1. Make a survey of the pure bred live stock in your school district, tabulate, and keep the tabulation with your laboratory notes.
2. From the 1920 U. S. Yearbook of Agriculture, page 731, secure the percentage of the different breeds of pure bred cattle in the United States. Secure and keep similar data for sheep, page 747 of the same book; and similar data for hogs, page 755.
3. Go to some farm having registered animals or pure bred poultry and let the proprietor explain to the class the characteristics of the breed and the advantages of his pure bred over scrubs.
4. If there is no boys' or girls' club in your school, organize one or both. Let this club raise some pure bred animals, keep an accurate record of them, and then exhibit them at the school fair and at that time let each boy and girl explain how the animals were fed, and the cost of raising them.

CHAPTER III

FEEDING FARM ANIMALS

THE matter of feeding well and economically is of the greatest importance to every farmer. Economic feeding means the most nourishing food at the lowest cost. It is often hard to discover the most satisfactory feeds for beef steers, sheep, swine, or poultry. We shall study the subject briefly here. For a fuller treatment of the matter refer to bulletins and textbooks.

Composition of feeds. — Feeds are chemically composed of water, carbohydrates, fats, proteins, and ash. *Water* in plants is an important part of the feed stuff. Green grasses contain more than three fourths water and all dry feeds contain about one tenth water. Blue grass is about three fourths water. Blue grass and milk are very similar in composition. Compare their composition as given in the following table.

Carbohydrates comprise the starches and sugars in plants. The elements carbon, hydrogen, and oxygen make up the carbohydrates. If we cut a wheat or corn kernel in two parts, we shall see a white substance that is starch. The flour of wheat is nearly all starch. Dry ear corn and wheat kernels contain about three fifths starch. Plants are largely composed of carbohydrates, and the cells of plants are on a carbohydrate basis.

Fats are found in many grains. Wheat is 2.1 per cent fat; cowpeas and soybeans contain 2.6 and 2.8 per cent of fat respectively. Fats are composed of the elements carbon, hydrogen, and oxygen. Fats are often spoken of as being concentrated carbohydrates.

DIGESTIBLE COMPOSITION OF SOME FEED STUFFS¹

(All analyses are given)

	TOTAL DRY MATTER	POUNDS OF DIGESTIBLE NUTRIENTS IN 100 LB.				
		Crude Protein	Carbo- hydrates	Fat	Total	Nutritive Ratio is as 1 is to
Corn products						
Dent corn	89.5	7.5	67.8	4.6	85.7	10.4
Gluten feed	91.2	15.1	57.8	4.8	83.7	4.5
Germ oil meal	92.2	10.0	50.3	10.0	82.8	7.3
Wheat products						
Wheat	89.8	9.2	67.5	1.5	80.1	7.7
Bran	89.9	12.5	41.6	3.0	60.9	3.9
Middlings	89.6	13.4	46.2	4.3	69.3	4.2
Oats						
Oats	90.8	9.7	52.1	3.8	70.4	6.3
Oat straw	88.5	1.0	42.6	0.9	45.6	44.6
Hays						
Timothy	88.4	3.0	42.8	1.2	48.5	15.2
Alfalfa	91.4	10.6	39.0	0.9	51.6	3.9
Red clover	87.1	7.6	39.3	1.8	50.9	5.7
Cowpea	90.3	13.1	33.7	1.0	49.0	2.7
Soybean	91.4	11.7	39.2	1.2	53.6	3.6
Grasses						
Blue grass	31.6	2.3	14.8	0.6	18.5	7.0
White clover	21.8	3.1	9.6	0.5	13.8	3.5
Red top	39.3	1.9	20.0	0.6	23.3	11.3
Meat products						
Tankage	92.5	48.1	0.0	13.7	78.9	0.6
Meat scraps	94.0	37.0	0.0	11.0	61.8	0.7
Cow's milk	13.6	3.3	4.9	4.3	17.9	4.4
Skim milk, gravity	9.6	3.1	4.6	0.9	9.7	2.1
Buttermilk	9.4	3.4	4.9	0.1	8.4	1.5
Corn silage	26.3	1.1	15.0	0.7	17.7	15.1
Cottonseed meal, good	92.1	31.6	25.6	7.8	74.8	1.4

¹ Henry and Morrison; "Feeds and Feeding."

Proteins are also found in plant tissue. Dent corn has 10 per cent protein; wheat, 12.5 per cent; and oats, 12.5 per cent. Protein substances contain the elements carbon, hydrogen, oxygen, and nitrogen, of which *nitrogen* is the most important. Nitrogenous feeds are called so because of their protein or nitrogenous content. The protein substances in grain crops are called gluten; in legumes, legumen; in eggs, albumen; in meat, myosin; and in milk, casein. The cell of animal tissue is on a protein basis.

The *ash* substances of feeding stuffs comprise the elements sulphur, phosphorus, potassium, calcium, magnesium, iron, sodium, silicon, and chlorine, which remain after a substance has been burned. Dent corn contains 1.5 per cent ash material; wheat, 1.9 per cent; and oats, 3.5 per cent.

The general facts of the above table have an important bearing upon feeding, and the study of the composition of feed stuffs has practical value.

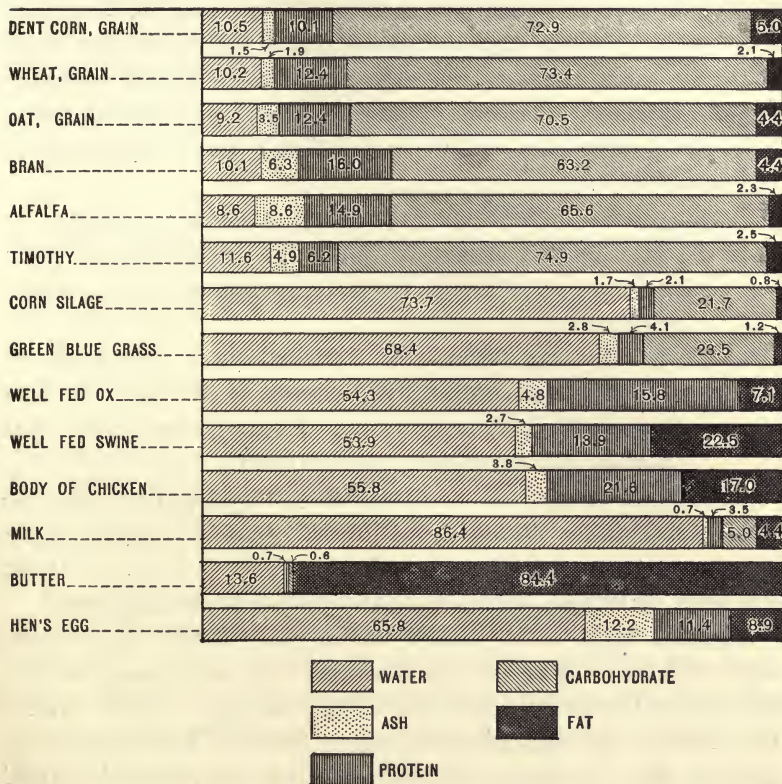
COMPOSITION OF ANIMAL BODIES AND THEIR PRODUCTS ¹

	WATER	DRY MATTER	PROTEIN	FATS	ASH	SUGAR
(Approximately)						
Beef steer	53.0	47.0	13.5	34.0	3.60	0.0
Fat pig	49.0	51.0	12.0	40.0	2.25	0.0
Fat lamb	47.8	55.2	12.3	28.5	2.94	0.0
Milk	86.4	13.6	3.5	4.4	0.7	5.0
Eggs (edible part) .	74.0	26.0	14.9	10.5	0.8	0.0

The study of the above table in comparison with the preceding one brings out the similarity of the composition of animal bodies and their products to the composition of plants and their products. This similarity of the chemical composition of animal

¹ Henry and Morrison; "Feeds and Feeding."

bodies and plants may be compared by studying the following diagram :



From the above diagram it may be seen that plant and animal tissue is somewhat similar in chemical composition. It may be noted, however, that plants contain a great deal of carbohydrate material, and that animals contain no carbohydrates. On the other hand, it may be observed that animal bodies contain a greater amount of protein material in proportion to the total dry matter found in animal tissue than is found in plant tissue. There is generally a greater proportion of fat in animal bodies than in plant bodies. Corn has 4.6 per cent fat, and a well-fed pig has 22.5 per cent. Corn has 67.8 per cent carbohydrates and the well-fed pig has none. As we shall see in a following paragraph, the carbohydrates are used for producing heat energy and fat. The diagram deserves close study. The figures show the percentage of nutrients found in each article given.

Function of food materials. — *Water* is used to build up body tissue. About 50 per cent of the body is made up of water. Milk and eggs are composed of 86 and 74 per cent of water respectively. It also helps to dissolve other foodstuffs and helps to carry them through the digestive canal. Water, through perspiration and otherwise, relieves the body of waste material. Through perspiration it aids in equalizing the temperature of the body.

Carbohydrates, the starches and sugars, have two functions :

1. To provide heat energy to the body. (Carbon, hydrogen, and oxygen, of which they are composed, are good heat producers.)
2. To provide fat. Since the composition of carbohydrates and fats is so similar, little change is necessary to convert a carbohydrate into fat. Every farmer knows that starches and sugars are good fatteners.

Fats, often defined as concentrated carbohydrates, have the same function as the carbohydrates. In cold regions more fats are fed because they furnish more heat. A pound of fat furnishes $2\frac{1}{4}$ times as much heat as a pound of carbohydrates.

Proteins build bone, muscle, connective tissue, horn, hoofs, skin, and hair. The protein foods are the only source of the proteins in the body. Proteins supply nitrogen, which cannot be supplied by the carbohydrates. Protein feeds make for growth, vigor, quality of skin and hair, and are essential to milk and egg production and work.

Ash elements in foodstuffs form bony tissues, help the blood, and aid digestion. The ash elements are important, but are not usually considered in figuring the nutritive ratios of feeding stuffs.

Food requirements of animals. — Food requirements vary with different conditions of work and temperature ; a few state-

ments are applicable generally. Physiologists teach us that the human body needs about eight times as much carbonaceous materials as protein substances. Agriculturists tell us that the following are the food requirements of different animals under the different conditions given :

	PART PROTEIN TO CARBOHYDRATES IN NUTRITIVE RATIO FOR DIFFERENT ANIMALS UNDER DIFFERENT CONDITIONS
Horses at light work	1 : 7.0
Horses at heavy work	1 : 6.0
Milch cows giving milk	1 : 6.8
Fattening steer	
First period	1 : 6.8
Second period	1 : 5.5
Third period	1 : 5.2
Fattening swine	1 : 5.5
For egg production	1 : 4.8
For growing fowls	1 : 4
For fattening chickens	1 : 7.5

Finding the nutritive ratio. — The nutritive ratio of a feed is found by multiplying the digestible fats by $2\frac{1}{4}$, adding the digestible carbohydrates, and dividing the result by the digestible proteins. To illustrate, corn has this composition: Fats 4.6 per cent, carbohydrates 67.8 per cent, protein 7.5 per cent. Then the N.R. of corn = $\frac{4.6 \times 2\frac{1}{4} + 67.8}{7.5}$ or 10.4, or the nutritive ratio of corn is 1 : 10.4. Likewise the nutritive ratio of any feed or food may be found.

Balancing a ration. — A milch cow requires a ration whose nutritive ratio is as 1 : 6.8. Since the N.R. of corn is 1 : 10.4, it is evident that it contains too much carbohydrate material. Therefore if corn is fed, some feed that contains more protein

must be added. Alfalfa is richer in protein than corn. Let us see what the N.R. of the following ration is.

	FATS	CARBO- HYDRATES	PROTEIN
10 lb. alfalfa hay = $\frac{1}{10}$ of 100 lb., or . . .	.09	3.90	1.06
5 lb. corn = $\frac{1}{20}$ of 100 lb., or . . .	.23	3.40	.37
20 lb. corn silage = $\frac{1}{5}$ of 100 lb., or . . .	.14	3.00	.22
Total	.46	10.30	1.65

$$\text{N.R.} = \frac{.46 \times 2\frac{1}{4} + 10.30}{1.65} = 6.8$$

or the N.R. of the above ration is 1 : 6.8.

A balanced ration is one in which the protein, carbohydrates, fats, and ash materials are fed in proper proportion. The needs of the animal, of course, must be taken into consideration in balancing a ration.

Some factors influencing the value of a feed.—In purchasing feeds the feeder of live stock or poultry is often at a loss to know what feeds to buy. First of all the matter depends upon what feeds are on hand. If corn silage, oat straw, and other carbonaceous feeds are on the farm or in the bin, then a feed rich in nitrogen, like cottonseed meal, tankage, or alfalfa hay, may be purchased, for these would serve to balance the ration to some extent. Of course it also depends upon the suitability of the feed. For illustration, no one feeds tankage to cattle, nor is cottonseed meal fed to hogs except in small quantities and for short periods. So the suitability of the feed is an item which must be considered.

The factors determining the usefulness of a feed are :

1. Digestibility
2. Nutritive ratio
3. Heat-producing ability
4. Bulk (partly)
5. Manurial value
6. Composition of the nutrients
7. Cost

Each will be briefly discussed.

1. The value of a feed is influenced by its *digestibility*. Again looking at the table on the digestible composition of feedstuffs, and noticing the column which shows the total digestible nutrients in each 100 pounds, we see that corn silage has 17.7 pounds and dent corn has 85.7 pounds. It will also be observed that all the hays given have approximately 50 pounds of digestible nutrients per each 100 pounds; while oats, wheat, and corn have approximately 70, 80, and 85 pounds respectively. Some plants and feeds are hard and fibrous, and hence have a relatively small value as a feed. It will be worth while to study the table closely and to compare the total digestible ingredients for each 100 pounds of feed stuffs.

2. The *nutritive ratio* is an important factor affecting the usefulness of a feed. Oat straw has a N.R. of 1:44.6, which is very wide. Oat straw is a valuable feed when supplemented by a small amount of cottonseed meal, N.R. 1:1.4. This combination makes a pretty good ration for maintaining and roughing stock through the winter. If you ask for prices, you will find that feeds having a narrow N.R. are more expensive. Those feeds that are cheapest and will balance the ration should be purchased.

3. The *heat-producing ability* of a feed is also an important factor in determining its value. This is an especially important consideration for winter or cold conditions.

Corn is an excellent feed to keep animals warm because it is rich in carbohydrates and fats, and it has a high percentage of digestible ingredients. A clean, dry stable with plenty of good bedding is a large factor in reducing the food required by animals for fuel purposes. As is indicated elsewhere, feed that is utilized in keeping up bodily heat does not produce gains. Feed can be saved by providing warm quarters in winter.

4. The value of a feed often depends to some extent upon its *bulk*, and vice versa. Corn silage, hays, the grasses, root crops, etc., are the roughage, and besides their composition they furnish bulk to the ration. It is because a ration must have bulk that dry matter is included in the Wolff-Lehmann standards. One reason why shelled oats is an excellent feed for a horse is that it has about 30 per cent hull.

Concentrates, such as the grains and legume seeds, and many of the commercial feed stuffs are valuable on account of their lack of bulk. Feeding both kinds of feeds, concentrates and roughages, will usually give best results.

5. One way to measure the usefulness of a feed stuff is by its *manurial value*. Corn silage has little fertility value, while cottonseed meal has a high fertility value. The manurial value is usually in almost direct proportion to the feeding value.

6. The *composition of the different nutrients* in a feed affects its feeding value to some extent. Casein in milk has a higher feeding value than gluten in corn, although both are protein substances. A balanced ration coming from the cereal kingdom will not make pigs grow as fast or cause hens to lay as many eggs, as if the ration is balanced with tankage. This is probably due to the fact that tankage provides the proper things in its protein make-up in a more balanced or suitable form.

The ash ingredients in plants and animals are also somewhat alike, as is shown by the following table.

POUNDS OF ASH INGREDIENTS IN 1000 POUNDS PLANTS AND ANIMALS

PLANT PRODUCTS

	PHOSPHORIC ACID	POTASH	LIME	MAGNESIA
Dent corn	6.9	4.0	0.2	1.8
Wheat	8.6	5.3	0.6	2.2
Oats	8.1	5.6	1.4	2.0
Wheat bran	29.5	16.2	0.9	7.3
Alfalfa hay	5.4	22.3	19.5	5.9
Cottonseed meal	26.7	18.1	3.6	8.6
Red clover hay	3.9	16.3	16.0	4.5

ANIMAL PRODUCTS

Fat calf	15.35	2.06	16.46	0.79
Fat pig	6.54	1.38	6.36	0.32
Fat lamb	11.26	1.66	12.81	0.52
Milk	2.00	1.70	1.70	0.20
Wool	0.70	56.20	1.80	6.40

This table indicates that corn contains 0.2 pound of lime in a thousand pounds and 6.9 pounds of phosphorus. Alfalfa has 19.5 pounds of lime and 5.4 pounds of phosphorus. This shows that the ash ingredients are found in different feeds in different proportions. This is also an important factor in the feeding value, for in milk production and in growing animals both must be provided. Therefore, since alfalfa and bran are quite similar in all other respects, the mineral composition may become the determining factor in the purchase of these feeds, for two thousand pounds of each feed will bring better returns than four thousand pounds of either. Some people say feed a variety; that depends upon the composition of the ingredient that makes up the feeds.

7. The *cost* of a feed affects its economical value. The feeding value of a feed remains the same regardless of its price. Bran dropped fifty cents a hundred yesterday. Its feeding value was not changed a particle.

The price of every ration should be figured, and it may be quickly done as follows, by taking the current prices.

COST OF THE DAILY RATION OF A DAIRY COW

	PRICE PER TON	PRICE PER 1000 POUNDS	PRICE PER 100 POUNDS	PRICE PER POUND	TOTAL COST OF RATION
40 pounds silage	\$ 4.00	\$ 2.00	\$0.20	\$0.002	\$.08
10 pounds oat straw	10.00	5.00	0.50	0.005	.05
5 pounds bran	30.00	15.00	1.50	0.015	.075
5 pounds alfalfa	16.00	8.00	0.80	0.008	.04
2 pounds cottonseed meal	40.00	20.00	2.00	0.02	.04
Total cost					\$0.285

The cost of this ration is 28.5 cents, and the bran cost 7.5 cents of the amount, or more than one fourth of the entire ration. Would it not be better to reduce the bran in the above ration on account of cost?

The question naturally arises: What is corn silage worth when timothy hay is selling for \$16 per ton? What is the relative feeding value of bran and alfalfa? Wheat and corn? etc. The composition and N.R. of the feeds, and the feeds already on hand will determine this to some extent.

Cost and feeding value are the two big factors measuring the usefulness of a feed.

Summary. — The question of properly and economically feeding farm animals is one of the most difficult and important farm problems. A careful study of the result desired will be a help in providing the best feeds. The feed requirements of animals

vary with work and conditions. Thus a horse at heavy work requires more protein than one that is doing light work. The feeds should be properly balanced so that the correct nutritive ratio is provided.

LABORATORY EXERCISES AND HOME PROJECTS

1. Find the cost per ton, and per one hundred pounds, of each of the feeds fed to at least three kinds of animals.

Also find the number of pounds of each of the feeds fed to some farm animal, and find the cost of the ration for one day.

2. Compare closely the composition of alfalfa and bran; silage and alfalfa; corn and wheat; milk and skim milk; tankage and cottonseed meal. Compare the feeding value of each pair of feeds suggested.

CHAPTER IV

THE HORSE

Importance of horses. — Horses are appreciated more to-day than ever before. The tractor and improved machinery have not displaced the horse to any great extent. The number and value of the different farm animals follow: ¹

	NUMBER IN U. S.	AVERAGE VALUE	TOTAL VALUE
Horses	21,491,544	\$ 90.13	\$1,783,307,389
Mules	5,828,873	142.88	778,768,092
Beef cattle	35,424,458	50.00	1,748,146,184
Dairy cattle	31,386,378	61.00	1,886,188,430
Swine	62,006,556	16.66	988,807,681
Sheep	35,435,266	11.30	395,152,231

From this table it may be seen that horses and mules stand first in total value, dairy cattle second, and beef cattle third.

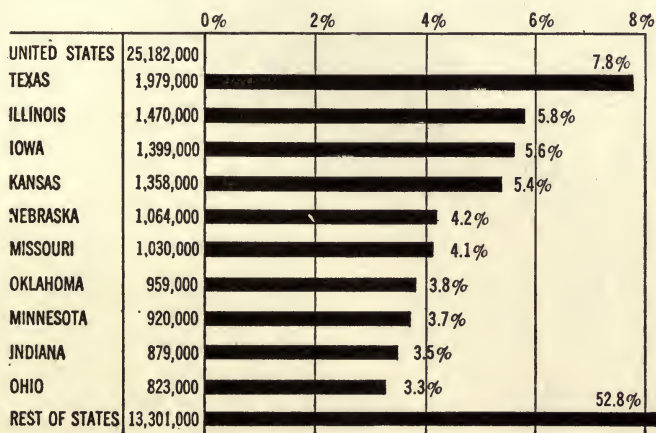
Horses have not decreased in the last ten years in the United States. According to the census reports there were 24,000,000 horses and mules in the United States in 1910, and over 27,000,000 in 1920. Contrary to the belief of some people, the horse and mule remain popular in spite of the wide use of the tractor and the truck.

Note to the Teacher: The materials needed to do the Laboratory Exercises and Home Projects suggested at the close of this chapter are:

Two draft and two light horses to judge; a saddle horse; and a five-foot measuring tape.

¹ 1920 Census Report.

Essentials in judging horses. — A good judge of horses must be a close observer, quick to see deviations from a correct conformation. He must know the different breed characteristics and be able to tell the age of a horse, capable of detecting blemishes and unsoundnesses of horses and of passing judgment upon these points. Discussions of the things which will enable the pupil and farmer to improve themselves in putting a proper estimate on horses follow.



GRAPH 1. — The leading states in horse and mule production. (1922 est.)

Parts of a horse. — The skeleton of a horse is the framework upon which the conformation, action, and other important features of a horse largely depend. Each type has features that are distinctive; for instance, the draft horse has a larger frame and the bones are heavier. The pasterns are generally shorter and thicker than are the pasterns of the light horse.

The form of the skeleton affects the action. There are three or four important points considered in action; namely, length of stride, elasticity, trueness, and energy of action. Length of

stride is to some extent dependent upon the length and obliqueness of shoulder and pastern. Straight shoulders and pasterns give the horse a short stride, with heavy concussion, conducive

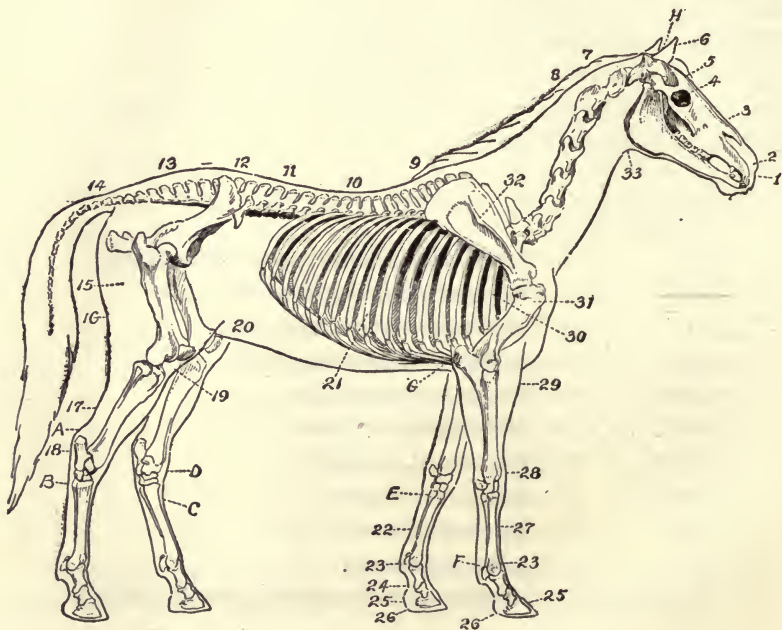


FIG. 7. — The parts of a horse.

1. Muzzle; 2. nostrils; 3. face; 4. eye; 5. forehead; 6. ear; 7. neck; 8. crest; 9. withers; 10. back; 11. loin; 12. hip; 13. croup; 14. tail; 15. thigh; 16. quarter; 17. gaskin or lower thigh; 18. hock; 19. stifle; 20. flank; 21. ribs; 22. tendons; 23. fetlocks; 24. pastern; 25. foot; 26. heel of foot; 27. cannon; 28. knee; 29. fore-arm; 30. chest; 31. arm; 32. shoulder; 33. throat latch; A. thoroughpin; B. curb; C. bog and blood spavin; D. bone spavin; E. splint; F. windgall; G. capped elbow; H. poll evil.

to blemishes. Elasticity and springiness are impossible with a straight shoulder and pastern. Trueness of action is dependent, to a large degree, upon the attitude of the legs. If the legs are straight, the action will be straight and true.

If from the front the knees are in or out, or if the front feet turn in or out, the action cannot be straight and true. Also if the hocks are in, as they often are, and the rear feet are out, the action will be untrue. The action of a horse is largely dependent upon the conformation of the skeleton.

Age of a horse. — Horses have two sets of teeth, a temporary and a permanent set. The temporary teeth make their appearance during the first and second months of the colt's life. They

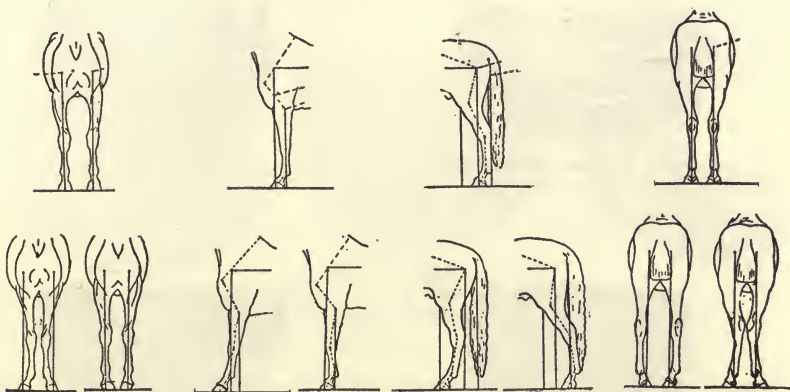
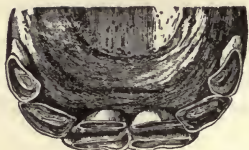


FIG. 8. — The upper four pictures show correct conformation that gives strength and trueness of action; the lower pictures illustrate incorrect conformation, which is conducive to poor action.

are small, very white, and soft. They change as follows: The middle incisors come out when the colt is two and one half or three years old, and permanent ones take their place. The intermediate incisors above and below disappear when the horse is three and one half or four years old, and permanent ones take their place. At four and one half or five years the corner incisors disappear, and the permanent ones take their place. At five, the permanent teeth are all present and the horse is said to have a full mouth. The permanent teeth are larger, darker in color, and of a harder texture than the milk teeth. To tell the age of a



Lower front teeth at three years of age.
Two center permanent teeth up.



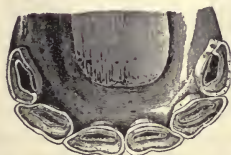
Lower front teeth at four years of age.
Four center permanent teeth up.



Lower front teeth at five years of age.
All permanent teeth up.



Lower front teeth at six years of age.
Cups out in center pair.



Lower front teeth at seven years of age.
Cups out of intermediate pair of incisors.



Lower front teeth at eight years of age.
Cups all out.



Upper front teeth at nine years of age.
Cups out of center pair.



Upper front teeth at ten years of age.
Cups out of intermediate pair.

colt under five years notice which temporary incisors are gone, and which ones are still present.

To tell the age of a horse after he is five, observe the disappearance of the cups in the teeth. The cups in the teeth of the lower jaw disappear first. The cups in the middle two lower incisors are gone when the horse is six years old; the cups in the intermediate lower incisors are gone at seven; and the cups of the lower corner incisors are gone at eight.

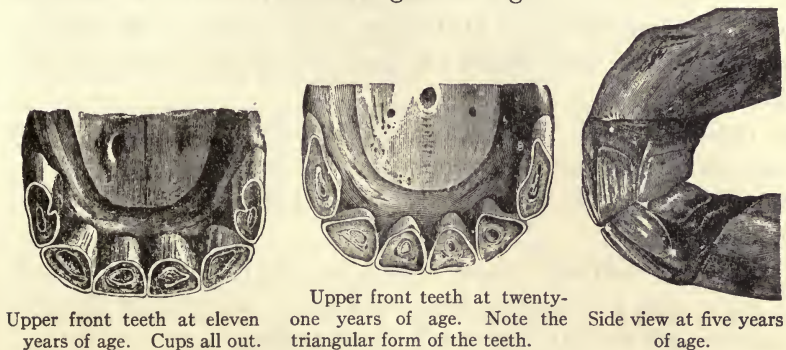


FIG. 10.

The cups in the upper jaw disappear from the middle, intermediate, and corner incisors at the ages of nine, ten, and eleven years respectively. The exact time at which the cups of horses' teeth disappear depends upon the texture of the teeth, the kind of feed, and the disposition of the horse. At twelve the horse has a smooth mouth. After twelve the age of a horse cannot be accurately told. Harper says,¹ "After a horse has passed the twelfth year, a year or two matters little. Much depends on the individuality of the animal, as some animals are worth more at fifteen than others at twelve. The value of a horse should then be determined from general appearances and activity rather than upon age."

¹ Harper; "Animal Husbandry for Schools."

Blemishes, unsoundnesses, and diseases of horses. — Blemishes are defects which do not interfere with the functioning of the part affected. Unsoundnesses do interfere with the functioning of the part affected. A wire cut may be a blemish only, because it may not interfere with the action of the horse. But a ring bone, side bone, curb, and similar defects do interfere with the proper functioning of the parts affected, and are therefore called unsoundnesses. A disease irritates parts of the body, so that the horse is sick. Distemper, bots, heaves, and colic are diseases. We shall study the most important blemishes and unsoundnesses.

Defective vision. Horses are often totally blind. This defect may be easily observed by looking at the horse's eye and watching the horse walk, for a blind horse will lift its feet higher than is natural.

Defective hearing. Some horses are hard of hearing. Such a horse does not respond when spoken to, and will use its eyes unduly, and the ears are usually held rigidly.

Poll evil appears between the ears over the poll. It is due to bruises of the poll, often caused by standing in a stable that has a low ceiling. The poll is bruised and becomes sensitive. The horse suffering from poll evil does not like to be bridled, because any touch on the poll is painful. This defect can usually be remedied by preventing irritation to the poll.

Sore shoulders are usually caused by an ill-fitting collar. A horse having shoulders that are 20 inches long and a bearing surface of 2 inches width, has a total of 80 square inches of bearing surface. If a collar fits well, and the horse pulls 2000 pounds, there is a weight of 25 pounds on each square inch. But if the collar is too long, all the weight of the load is borne on the shoulder point, or about 8 square inches. Then the weight and pressure on each square inch is 250 pounds and causes sore shoulders.

Sweeny is also a defect on the shoulder. The muscles over the shoulder blade shrink, and the remaining muscles apparently grow fast to the bone. It is difficult to lift the skin over the region affected.

Fistulæ are collections of pus, as indicated in Figure 11. This defect, like poll evil, is caused by a bruise. Often horses in rolling bruise the withers on a stone or hard soil and fistulæ result. They should be opened at the lowest point possible, and washed out with a three per cent carbolic acid solution or some other good disinfectant.



FIG. 11. — *Fistulæ*.

Capped elbow, occasionally called shoe boils, may be caused by the horse's hitting the elbow with the shoe of the rear foot upon lying down. Capped elbow does not interfere with the action of the horse.

Splints, bony deposits at the end of the splint bones, generally occur on the inner front cannon and sometimes near the tendon. Near the tendon a splint interferes with the horse's action much more than a splint on the inner front cannon.

Scratches appear on the rear of the pastern. Scratches are a chapped condition of the skin and are caused by the horse's standing in unclean, muddy, wet stables. Give the horse a clean stable, wash the parts affected, first with soap, and then with clean, well-boiled, salt water.

Ring bones and *side bones* are due to a bony deposit and occur just above the top of the hoof, generally on the front feet. There are two forms of side bones, high and low. Ring bones grow nearly all the way around the hoof, and side bones grow on the sides only.

Quarter cracks and *sand cracks*. Quarter cracks appear at the rear quarter of the foot, and sand cracks appear on the front part of the hoof. Corns and thrush are other blemishes of the feet.

Blemishes and unsoundnesses of the hock are the most common defects in horses. A *capped hock* is an enlargement and thickening of the skin of the hock. A *curb* is a bony deposit that appears about three or four inches below the hock and is



FIG. 12.— A capped hock and a curb.

more serious than a capped hock. *Thoroughpins* appear between the tendon and the bone, just above the hock. Thoroughpins are knot-like in shape and movable. *Bone spavins* appear on the inner lower point of the hock and may be seen from the front of the horse. *Bog spavins* are soft swellings made by the deposit of oil of the joint and appear in the natural depression on the inner and front part of the hock.

Wind puffs occur just above either the front or rear fetlocks.

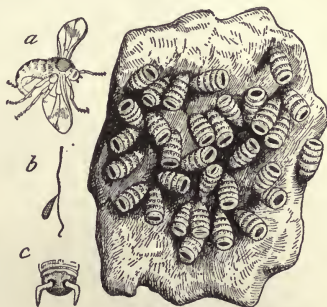
Distemper is a bad cold of a horse. It is very contagious; horses suffering from it should be isolated and not permitted to drink or eat with the other horses. Distemper may usually be cured by keeping the horse in clean, dry, warm, sunshiny quarters and feeding it carefully.

Heaves is a disease of the lungs in which the air sacs become distended and the muscles around the sacs lose their power to control exhalation. Air escapes from the lungs suddenly and loudly.

Bots are due to the bot fly which deposits its eggs on the front cannon of the horse, where they hatch. They cause an itching sensation and the horse bites them off and swallows them. The larvæ remain in the stomach of the horse for about nine or ten months, securing their food from the inner lining of the stomach. The best way to combat bots is to destroy the eggs while on the cannon by wetting well with kerosene or some disinfectant.

Every effort should be made to keep the horse free from blemishes, unsoundnesses, and diseases of all kinds.

Draft horse type.—Draft horses are large, compact, and heavy. When fat, they weigh from 1600 to 2300 pounds. The weight of draft horses affects the price. Heavy draft horses bring more per pound than light draft horses. In 1893 a Chicago firm found the average prices for the weights as follows: ¹



Courtesy of Orange Judd Co.

FIG. 13. — Bots in stomach. At right young bots attached to stomach wall. *a.* female bot fly; *b.* the bot; *c.* magnified head of bot.

AVERAGE WEIGHT	AVERAGE PRICE	CENTS PER POUND
1400	\$155.87	\$0.111
1450	159.15	0.109
1500	169.15	0.112
1550	176.56	0.114
1600	176.62	0.110
1650	208.64	0.126
1700	212.89	0.125
1750	236.14	0.126
1800	258.33	0.135

¹ Craig; "Judging Live Stock."



FIG. 14. — A Percheron type, showing the conformation, intelligence, temperament, and countenance desirable in a Percheron horse.



Courtesy of Hale Pub. Co.

FIG. 15. — A Percheron mare, showing the breed characteristics, form, and color that are most typically Percheron.

It will be seen from this table that horses weighing 1800 pounds brought more than \$100 more than horses weighing 1400 pounds. Weight is an important factor in draft horse values.

The importance of quality of bone, skin, and hair of a draft horse can hardly be overemphasized. Roughness of bone, showing blemishes and unsoundnesses, is a bad condition. The leg should be flat and wide, with well-defined tendons. The skeleton of a draft horse is better covered than that of a light horse, and therefore blemishes are often difficult to detect. Sound texture of bone and foot are desirable points. A good foot is essential to any horse. The old saying, "no foot, no horse," is correct. A sound, tough-textured, good-sized, concave, solid foot is essential in a draft horse. The legs and feet should be straight from the front and the back. A well-sloping shoulder and well-sloping pastern are essential. A long, regular, true, elastic walk is the essential gait of this type of horse.

Draft horse breeds. — The *Percheron* horse originated in La Perche, France. All horses used in France for breeding purposes are examined by government veterinarians and are classified as follows:

1. Approved horses are the best, and the owners are given a bonus yearly of \$60 to \$100 as a subsidy by the national government.

2. Subsidized horses are the next best, and owners of this class of horses are given a bonus of about \$60 yearly.

3. Authorized horses belong to the poorest class and are permitted to be used as breeding stock but are considered mediocre horses, — and their kind is discouraged. Such government support as the above helps in building up a definite type of animal.

Percheron horses have been imported in large numbers into the United States and are found chiefly in Illinois, Iowa, Ohio,

Indiana, Michigan, Wisconsin, New York, Pennsylvania, and Minnesota.

Percheron horses have definite breed characteristics. They are usually black or gray in color, $15\frac{1}{2}$ to 17 hands high, weighing from 1600 to 2100 pounds. They have a strong conformation and are

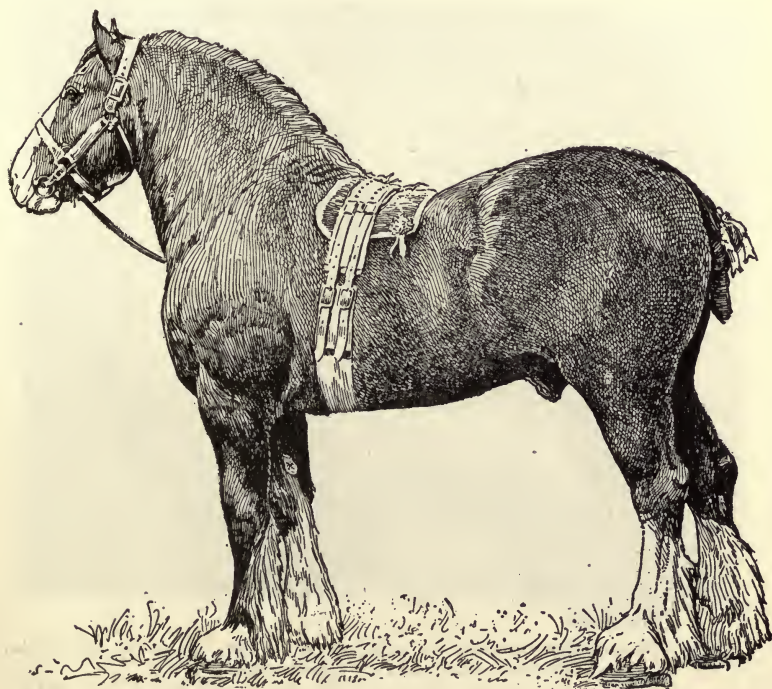


FIG. 16. — Baron's Pride. Said to be the greatest Clydesdale sire in the world. Shows the conformation, sloping shoulders and pasterns, short back, and a distribution of white points that stamp this breed.

noted for their constitution and endurance. They generally have excellent feet, excellent heads and necks, and in every respect are fine horses. For a combination of constitution, endurance, feet, speed, and strength, they have few equals and no superiors.

The *Clydesdale* horse has been developed by Scotch breeders along the Clyde River in Scotland. Though they are of mixed origin, since about 1850 they have been kept pure. Clydesdale horses are now found chiefly in Germany, Russia, Sweden, Argentine Republic, and the United States.



FIG. 17. — A Shire stallion, showing the most approved type combining size, weight, conformation, draft, and color typical of this breed.

The Clydesdales are typical draft horses, being about 16 to 16½ hands tall and weighing from 1600 to 2100 pounds. They are usually bay and brown in color, with often one or more white feet, and sometimes a white-blazed face. Their shoulders and pasterns are oblique and help to give them good action. The feet, bone, and action are emphasized by the Scotch breeders.

The ribs of the Clydesdale horses are often comparatively short. This makes for a body that lacks depth. The action of the Clydesdale is unsurpassed by other breeds of draft horses. Some people object to their lack of length of rib and to their hairy fetlocks.



FIG. 18. — Belgian draft horse.

The English *Shire* horse is the draft horse of England. It is a large horse equaled only by the Belgian horse in weight. These horses weigh, when fat, from 1800 to 2400 pounds. They are generally black, bay, or gray in color, with white markings on the forehead and on the legs below the knee. The Shire is a strong, massive draft horse. They are found mainly in English-speaking countries. There are some Shires in the United States.

The *Belgian* is the largest of all the draft breeds. Figure 18 is a fair representation of the Belgian type.

The *Suffolk (punch)* horse originated in England. It is chestnut in color and the smallest of the draft breeds.



FIG. 19. — A Hackney coach horse.

Coach horses. — Coach horses range from 15 to 16½ hands high and weigh from 1000 to 1500 pounds. The German Coach, the Hackney, and Cleveland Bay of England, and the French Coach represent the coach breeds. The German Coach is the

largest and the Hackney the smallest of this type. The Hackney is known for its high knee and hock action. The principal gait of the coach horse is the trot.

Light horses. — Light horses comprise the English Thoroughbred, American Saddle horse, the Standard-bred horse, the



Courtesy of the Agricultural Extension Department, Purdue University.

FIG. 20. — Strength and speed. Note width of breast, and short straight pasterns of the one in contrast to light and long oblique pasterns of the other one.

Arabian, and Orloff Trotter. The Thoroughbred is the English running horse. The American Saddle horse is either a three- or five-gaited horse. The Standard-bred horse is bred for speed. These horses trot or pace. The Standard-bred horse and the American Saddle horse furnish much entertainment at state fairs.



Courtesy of the Show Horse Chronicle, Lexington, Kentucky.

FIG. 21. — Rex McDonald 833, — an American saddle horse, showing the beautiful form, the stylish carriage of head and tail, and the intelligence of this breed.

Market classes of mules. — There are five market classes of mules. (1) The plantation mules are of two kinds, the sugar plantation mule and the cotton mule. Sugar plantation mules are 15 to 17 hands tall and weigh 1100 to 1500 pounds. They are better than other mules in quality, style, and action, and bring the highest prices. The cotton mules range from $14\frac{1}{2}$ to $15\frac{1}{2}$ hands and weigh from 850 to 1100 pounds. They have medium-sized bones, are compact, and of good style. (2) The lumber mules range from $15\frac{1}{2}$ to $16\frac{1}{2}$ hands, weigh from 1250 to 1600 pounds and possess more ruggedness and bone than do the sugar mules. (3) Railroad mules are the same height as lumber mules but weigh a little less. Quality and action are essential points of this mule. (4) Levee mules are about the same as railroad mules but possess a little more substance and can do harder work. They are used as draft animals. Soundness and working ability are emphasized. (5) The mining mules are from $12\frac{1}{2}$ to $14\frac{1}{2}$ hands, and weigh about 700 to 900 pounds. They must possess rather heavy bones and be rugged in order to do the work in the mines.



FIG. 22. — A matched mule team. Note the fine, gentle, docile countenances of these mules. They are superior and safe workers.

Prices vary, but the mining mules and cotton mules are generally the lowest-priced mules; mules belonging to the other classes have a ready sale and bring good prices and are, therefore, profitable for production.

Factors influencing the work of the horse. — There are several things which influence the work of the horse. High wheels are more easily pulled than low ones; a 12-inch plow pulls proportionately easier than a 16-inch plow; a sloping mold-board pulls easier than a straight one; eight 2-inch shovels pull easier than four 4-inch shovels; roller and ball bearings reduce the draft and a rolling and cutting coulter does the same. Since horse power is so generally used on the farm, it behooves the farmer to do everything possible to reduce the draft and thus aid the horse.

Care and management of horses. — Occasionally horses' teeth do not wear down evenly, and a little filing will take away the uneven sharp edges left on the upper corner incisors.

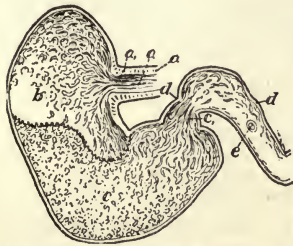
Horses should not be exposed to a cold brisk wind or left out in the cold when they have been driven hard. Blanketing the horse will prevent disease and protect it somewhat against extreme cold temperatures.

The feet of a horse need constant attention if it is being worked. Dry hoofs should be oiled, and shoes should be carefully put on and renewed frequently. The entire length of the horse's foot grows out in from 3 to 14 months. At the rear, where the foot is short, it grows out in 4 months. At the front the entire length is repaired by new tissues in about 12 to 14 months. Since the foot is larger near the bottom than at the top of the hoof, and since the hoof grows quite rapidly, shoes should be taken off and refitted to the foot. Poor action and blemishes are often due to poor shoeing. It is better to fit the shoe to the foot than the foot to the shoe.

Horses should be groomed in the morning and at the close of the day. Grooming has other values than merely improving the appearance of the horse. Brushing off the perspiration at the close of the day improves the condition of skin and hair and reduces the chances of the horse's becoming chilled.

Training horses. — Colts should be handled very early in life and may be made gentle. They may be taught to stand over, back, or move forward. A few simple things taught the colt saves a lot of energy later and secures better results.

When a young horse is being trained to work, it should be hitched beside a well-trained, easily controlled, sensible horse. The early training of a colt is important, for then it forms habits



- a, a, a. End of esophagus.
- b. Forestomach.
- c. True digestive part.
- c₁. Pyloric orifice.
- d. Duodenum.
- e. Orifices of bile and pancreatic ducts.

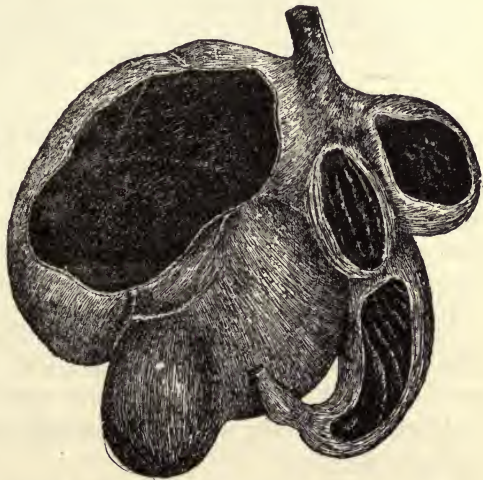


FIG. 23. — A simple and a compound stomach.

which stick to it afterward. For illustration, if a colt is allowed to start as soon as or before the driver gets into the wagon, the habit will be hard to overcome. But, on the other hand, if it is trained to stand until the driver says go, this habit will remain with it always. It is for this reason that a few simple things should be taught a horse when it is being trained. Horses will do what you ask them to do, but first they must be taught what is wanted.

Feeding horses. — The digestive organs of different farm animals vary in capacity. Horses and swine have one stomach, while the ruminants, cows, sheep, and goats, have several stomachs. The picture on the preceding page will give an idea of the difference.

The capacities of the digestive organs of the different animals as given by Harper are as follows : ¹

LENGTH OF INTESTINES AND CAPACITY OF STOMACH OF FARM ANIMALS

	CAPACITY, QUARTS		TOTAL QUARTS	LENGTH, FEET, OF INTESTINES
	Stomach	Intestines		
Horse	19.0	204.8	223.8	98.1
Cow	266.9	109.8	376.7	187.2
Sheep	31.3	15.4	46.7	107.3
Hog	8.5	20.5	29.0	77.1

It will be observed from the table that the horse and hog have smaller digestive organs, and for this reason their food must not be so bulky as the feed of cows and sheep.

A few rations for work horses weighing 1250 pounds will be in order here :

{ Oats 12.0 lb.	{ Oats 10.0 lb.
{ Timothy hay 13.0 lb.	{ Corn 5.0 lb.
	{ Hay 15.0 lb.
{ Corn 10.8 lb.	{ Corn 5.0 lb.
{ Oats 8.0 lb.	{ Oats 5.0 lb.
{ Timothy hay 10.0 lb.	{ Bran 5.0 lb.
{ Oat straw 5.0 lb.	{ Timothy hay 10.0 lb.

The nutritive ratio of one or two of these rations should be figured according to data given in the preceding chapter on feeding farm animals.

¹ Harper ; " Animal Husbandry for Schools."

Summary. — In judging a horse it is important to know the age and to be able to detect any unsoundnesses. The formation of the skeleton determines largely the action, shape, constitution, and endurance of the horse. The draft horse must be able to walk well; the coach horse must trot well; and light horses must be able to perform at different gaits. The early training of a colt is important, for the habits horses learn in their youth remain with them. Proper feed and care increase the usefulness of a horse. A horse can hardly be expected to do its best unless it has a good driver and well-fitting harness.

LABORATORY EXERCISES AND HOME PROJECTS

1. (a) In the draft horse, note the large frame; size and strength of the bones; and the short, thick pastern. Note the lightness of frame and the length of the pastern of the coach horse. Study the action, noting the length of stride, elasticity, trueness, and energy. How does the light horse differ from the coach horse, and the draft horse? (b) With a plumb line, made by tying a little rock or a piece of lead to a string, study the skeleton of a horse, as to straightness from the shoulder point and buttock and also from the sides.

2. Examine several horses and tell their ages. From what teeth can you tell the age of horses under nine years? Over nine years? What points are observed on the lower front teeth of a horse three years old? Four years old? How can one tell the age of a horse under five years? How can one tell the age of a horse after he is five years old? After he is nine years old? After what age is it impossible to tell accurately the age of a horse?

3. With a horse before you, tell where blemishes are located and the character of each.

4. Take measurements with a tape of the following points of a draft horse and a light horse and record in the following table.

To make these measurements accurately you will need to study the parts of the horse shown on the following page. On Figure 24 indicate the distances in the table that are to be measured, and practice until you can

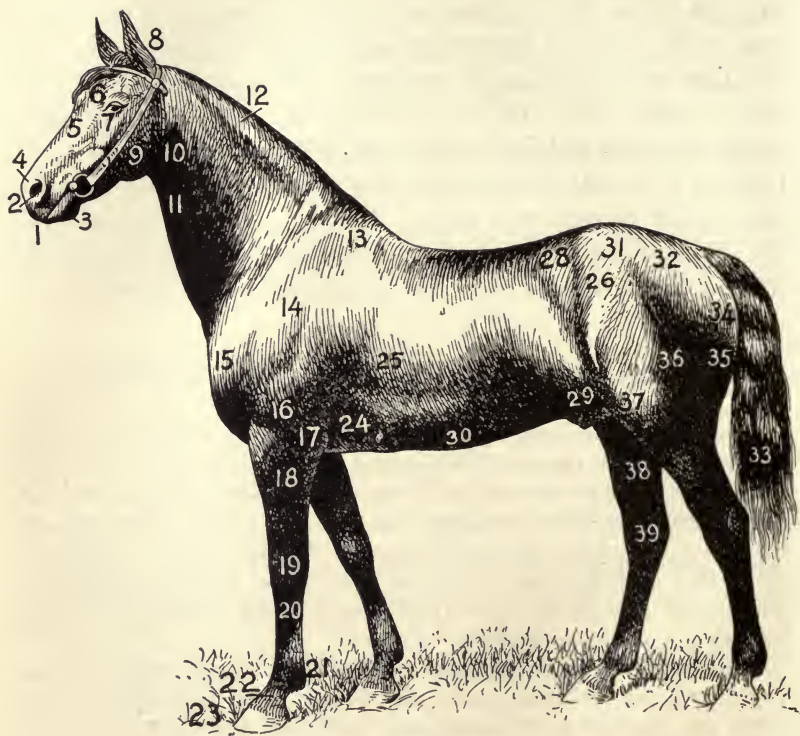


FIG. 24. — Parts of a horse.

- | | | |
|-------------------|------------------|------------------|
| 1. Mouth. | 14. Shoulder. | 27. Back. |
| 2. Nostril. | 15. Breast. | 28. Loin. |
| 3. Chin. | 16. Arm. | 29. Rear flank. |
| 4. Nose. | 17. Elbow. | 30. Belly. |
| 5. Face. | 18. Forearm. | 31. Hip. |
| 6. Forehead. | 19. Knee. | 32. Croup. |
| 7. Eye. | 20. Cannon. | 33. Tail. |
| 8. Ear. | 21. Fetlock. | 34. Buttock. |
| 9. Lower jaw. | 22. Pastern. | 35. Quarters. |
| 10. Throat latch. | 23. Foot. | 36. Thigh. |
| 11. Windpipe. | 24. Fore flank. | 37. Stifle. |
| 12. Crest. | 25. Heart girth. | 38. Lower thigh. |
| 13. Withers. | 26. Coupling. | 39. Hock. |

locate the points at once. How many of the parts mentioned on Figure 24 can you locate correctly without the aid of the figure numbers?

	DRAFT		LIGHT	
1. Length of head from lips to poll				
2. Length of neck from poll to withers				
3. Height at withers				
4. Height from withers to elbow				
5. Distance from elbow to ground				
6. Length of shoulder				
7. Length of arm				
8. Length of forearm				
9. Length of cannon				
10. Distance around cannon				
11. Distance from fetlock to ground				
12. Angle of front pastern				
13. Girth measure				
14. Length of back from withers to hip				
15. Length from shoulder to buttock				
16. Length of croup				
17. Length of gaskin				
18. Distance from hock to ground				
19. Height at croup				
20. Angle of hind pastern				
21. Width through breast				
22. Width over hips				
23. Weight				

SCORE CARD FOR HORSES — DRAFT (*Continued*)

SCALE OF POINTS		PERFECT	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED
Pasterns, angle 45 degrees, not too long, showing strength	2									
Feet, even sized, large; horn, dark colored; sole, concave; bars, strong; heels, wide apart; frog, large	6									
4. Body — 10 points										
Chest, ribs well sprung, deep, showing constitution, half the height of horse .	3									
Breast, broad, deep, and muscular . .	1									
Ribs, long, round curvature, well sprung	2									
Back, short, straight, muscular, broad .	2									
Loin, wide, short, closely coupled . .	1									
Underline, long, and flanks, low . . .	1									
5. Hind quarters — 30 points										
Hips, level, wide, and smooth	1									
Croup, wide, long, fairly level	4									
Tail, set high and well carried	1									
Thighs, well muscled	3									
Quarter, heavily muscled and well descended	2									
Gaskin, medium, straight, wide, well muscled	3									
Hocks, clean cut, large, straight, free from blemishes	6									
Cannons, 11-12 inches long, clean . .	2									
Fetlocks, wide, clean, strong	1									
Pasterns, angle of 60 degrees, free from puffiness	2									
Feet, well set; concave soles; heels, high, well apart, and of a good texture	5									
Total	100									

6. If there is a saddle horse in the community, have the owner bring it to school and let him demonstrate the gaits of a saddle horse. A three-gaited horse must go the walk, trot, and canter. A five-gaited horse

goes the following gaits in addition: racks and paces, or foxtrots, a running walk or a slow pace.

7. Score a light horse according to the following score card:

SCALE OF POINT		PERFECT	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED
1.	General appearance — 43 points									
	Age, estimated									
	Height, estimated	4								
	Weight, estimated	4								
	Form, symmetrical, high, light, indicative of good action	4								
	Quality: bone, fine; tendons, defined; skin and hair, fine	8								
	Action, quick; step, long, true, and regular; trot, rapid and even	15								
	Attitude: members, vertical	4								
	Temperament, lively, energetic, intelligent, docile	4								
2.	Head and neck — 5 points									
	Head, lean, clean cut, well-defined features, carried high; profile, straight	1								
	Muzzle, fine; nostrils, large; lips, thin and even	1								
	Eyes, full, bright, and intelligent	1								
	Ears, short, alert, well carried	1								
	Neck, well fitted to head, slightly arched, clean, large windpipe	1								
3.	Fore quarters — 19 points									
	Shoulders, oblique and well set back	2								
	Arms, short, well set back	1								
	Forearms, long, 12-13 inches, well muscled, and clearly defined	2								
	Knees, clean cut, wide, deep, well supported	3								
	Cannons, 10-11 inches long; tendons, well attached and defined	2								
	Fetlocks, free from puffiness	1								
	Pasterns, long, sloping	2								

SCALE OF POINTS

	PERFECT	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED
Feet, fair size; horn, dense; concave sole; frog, large and elastic; heels, wide apart	6								
4. Body — 8 points									
Chest, higher than for draft horses, showing constitution	2								
Withers, clearly defined in driving horses, less in coach horses	1								
Breast, high and projecting	1								
Ribs, long and well sprung	1								
Back, fair length, well muscled	1								
Loin, strongly joined to hips	1								
Underline, long, fairly straight	1								
5. Hind quarters — 25 points									
Hips, rather prominent	1								
Croup, wide, long, muscular, and horizontal	3								
Tail, set high, well carried, long, full, and fine	1								
Thighs, 15-16 inches long; stifle, deviated outward	3								
Buttock, heavily muscled	1								
Gaskin, 14-15 inches long, well muscled, wide	2								
Hocks, clean, 3 inches deep, straight	4								
Cannons, 11-12 inches long; tendons, well defined	2								
Fetlocks, clean, no wind puffs	1								
Pastern, long, sloping	2								
Feet, even sized; concave sole; heels far apart, tough textured	5								
Total	100								

CHAPTER V

BEEF CATTLE

Importance of beef cattle. — The total number of cattle in the United States in 1920 according to the last census was 68,922,764. Of this number 31,386,378 were dairy cows, leaving 37,536,386 other cattle used for beef production. The value of all cattle exclusive of the dairy cows was \$1,748,146,184. The value of beef cattle per head was \$50.

Beef cattle are distributed throughout the United States, but about 48 per cent are found in the North Central States and Texas.

Reasons for beef production. — Beef cattle are produced primarily for four classes of people, — the breeders, the feeders, the retail butchers, and the consumers; and the real purpose of beef production is to furnish food for man. In judging cattle, the purpose for which they are to be used should be considered. The butcher considers small bones important, because a small-boned animal gives a higher per cent of dressed carcass. The feeder wants a steer that will put on a maximum amount of beef with the minimum of feed. In judging breeding stock, breed characteristics, conformation, quality, and temperament can hardly be overemphasized. The points of excellence held by the breeder, feeder, butcher, and consumer should be kept in mind when judging.

Note to the Teacher: The materials needed to do the Laboratory Exercises and Home Projects suggested at the close of this chapter are:

A beef cow to show the beef cuts; and a Shorthorn, Hereford, and Angus cow to judge.

Leading cattle-producing nations. — The number of cattle given in the following table comprises all cattle. Any nation having less than one million cattle is not included. The reason for giving such data is that the price level on beef cattle and beef products is largely controlled by the supply of cattle in the leading cattle-producing nations. The first ten or twelve nations given below, generally speaking, control the beef markets of the world. The leading beef-producing nations and the number of cattle in each follows :

THE LEADING BEEF-PRODUCING NATIONS

	NUMBER OF CATTLE		NUMBER OF CATTLE
British India	129,876,000	Italy	6,240,000
United States	68,922,764	Hungary	6,045,000
European Russia . . .	38,373,000	Paraguay	5,550,000
Brazil	37,500,000	Mexico	5,142,000
Argentina	27,392,000	Cuba	3,962,000
Germany	16,904,000	Spain	3,712,000
Asiatic Russia	14,772,000	New Zealand	3,059,000
France	12,374,000	Denmark	2,286,000
Great Britain	11,770,000	Sweden	2,250,000
Australia	11,040,000	Chili	2,225,000
Canada	9,477,000	Poland	2,014,000
Uruguay	7,803,000	The Netherlands	1,969,000
Madagascar	6,676,000	Japan	1,307,000

The United States has about one seventh of the cattle of the world. The cattle of the United States are generally better than the cattle of some of the other countries.

Characteristics of beef cattle. — Beef cattle are low, compact, rectangular, and heavy. They are “bricklike” in form. The top line and under line are almost straight and parallel. The back is broad, and the body is deep. The quarters are fleshy and well descended. The body is blocky. Roughness is to be avoided.

The head is a good index to the body characteristics. A steer with a wide head, large box-shaped muzzle, and large nostrils is usually a good feeder. Large nostrils show breathing capacity. The ears should be medium in size, should not be coarse, and should show quality. If horns are present, they should be of



Courtesy of the Agricultural Extension Department, Purdue University.

FIG. 25. — A typical beef type; bricklike in conformation from side, front, and top view.

fine texture and rather small. A steer with these head characteristics is usually compact, blocky, a good feeder, and will dress out, when well finished, a high per cent of edible dressed meats.

On the other hand, a steer with a thin long face, a thin narrow forehead, a small muzzle, small nostrils, large, coarse ears, and long, rough, oversized horns, is generally unprofitable. The features of the head are correlated with similar features in the rest of the body. (See Figs. 25 and 26.)

Most valuable cuts. — The picture (Fig. 27) shows the way a steer is cut for the retail beef trade. It is taken from Farmers' Bulletin, No. 711, and shows the Chicago retail dealer's method of cutting beef. It should be studied because it shows where beef cattle ready for slaughtering should be well formed and finished. The region from which the porterhouse steak, prime



Courtesy of the Agricultural Extension Department, Purdue University.

FIG. 26. — An inferior feeder.

of rib, and sirloin cuts are taken is important. A broad, well-finished back is a sign of a great amount of meat in the region of these valuable cuts. There are some cuts which are actually worth less after the steer is slaughtered than they were when the steer was alive.

A steer of good quality, that is of fine bone, skin, and hair, well finished, and evenly, firmly, and smoothly fleshed, weighing

1200 pounds, will dress out about 800 pounds (about 66 $\frac{2}{3}$ per cent), and of this about 700 pounds of meat can be eaten. Careful

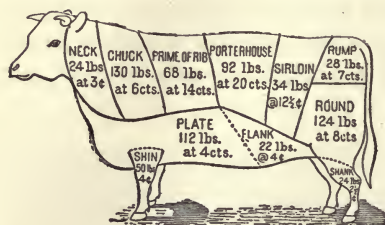


FIG. 27.— Picture of a 1200-pound beef steer, showing cuts and their relative value, according to a large packing concern.

judging of beef cattle and a close study of the score card will aid a great deal in placing proper estimates upon the different sections of a beef type.

Beef cattle breeds.— All the typical beef breeds have the characteristics pointed out in the above paragraphs. They vary slightly in different sections

of the country, in temperament, in color, in milk production, and in other minor points. For a more extended discussion refer to other texts and especially to “Types and Breeds of Farm Animals,” by C. S. Plumb. The most important breeds of beef cattle are Shorthorn, Hereford, Aberdeen Angus, and Galloway.

1. *Shorthorn cattle.* a. *History.* The origin of the Shorthorn cattle is as mixed as are the people of England. The native Celts, the Romans, Anglo-Saxons and Jutes, and the Normans, all brought cattle that served to lay the foundation of the Shorthorn breed. However, not until about 1775 to 1875 were the Shorthorns developed into a well-defined breed. The following men developed slightly different types of Shorthorns as follows:

	BORN	DIED	TYPE
Thomas Bates	1775	1849	Dairy-beef type
Chas. Collings	1749	1836	Beef type
Robt. Collings	1750	1820	Beef type
John Booth	1789	1857	Beef type
Richard Booth	1788	1864	Beef type
Amos Cruickshank	1808	1895	Beef type

These were the men who started the real history of the Short-horn cattle. All of these men did their work in England except Amos Cruickshank, who was in Scotland.

Although Shorthorn cattle were imported into the United States as early as 1783, the Ohio Importing Company, organized in 1833, was the most important agent in introducing Shorthorn cattle into the United States. The first importation included nineteen head. In 1836, forty-three animals, including those that were imported and their offspring, were sold at public auction for \$34,540, an average of \$803.25 per head. The Shorthorn characteristics were so excellent that they were soon distributed throughout the country.

No other breed has been used as much as the Shorthorn in crossing and grading up native cattle. The entire West and the South American countries have been materially benefited by mating native stock with Shorthorns. The pure bred sire produced an animal that dressed out a higher per cent of carcass, had shorter horns, had a better disposition than the native cattle, and was more easily handled. The rapid elevation of good characteristics as a result of crossing was a splendid financial investment. Such opportunities in breeding up herds, though not so numerous as formerly, are still present. Ordinary farm herds may be improved a great deal by mating with animals of the same breed, that are pure bred and of the proper conformation.

b. Characteristics. In England three types of Shorthorns were developed; namely, the beef type, the dairy type, and the dairy-beef type (dual purpose). Each type has a different conformation, in accordance with its purpose. In the United States, the beef type is more commonly found, because our agricultural conditions are somewhat different from those of England. In England the dairy type is common, and the English

people depend largely upon the Shorthorn cow for their milk supply. "At the London Dairy Show, from 1894 to 1904 inclusive, the first place in both milk production and fat production was won in every case by a Shorthorn, competing against Jerseys, Guernseys, Ayrshires, Red Polled, and crosses."¹

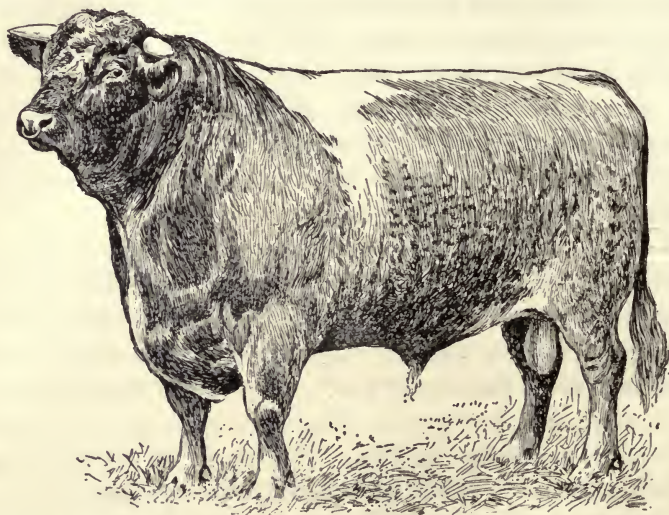


FIG. 28. — A Shorthorn type, showing conformation and head characteristics which stamp this breed.

Shorthorns are red, white, and roan. A mixture of red and white is roan. Some breeders have placed more emphasis upon color than upon other points. This is a mistake, for color is a matter of secondary importance. Beef-producing qualities should be placed first. The Shorthorns rank first among the beef breeds in udder development and in milk-producing ability. They may occasionally be criticized in being slightly rangy and in having prominent shoulders. They may be regarded as the

¹ C. H. Eckles; "Dairy Cattle and Milk Production."

largest of the beef breeds. The males weigh from 1800 to 2400 pounds, and mature cows from 1400 to 1800 pounds.

2. *Hereford cattle.* a. *History.* This breed originated in the county of Hereford, England. Their origin is somewhat obscure, and according to the opinions of some authors the Hereford is the oldest of the beef breeds. But, like the Shorthorn breed, it was not until about 1723 that the Hereford breed was developed with definite breed characteristics.

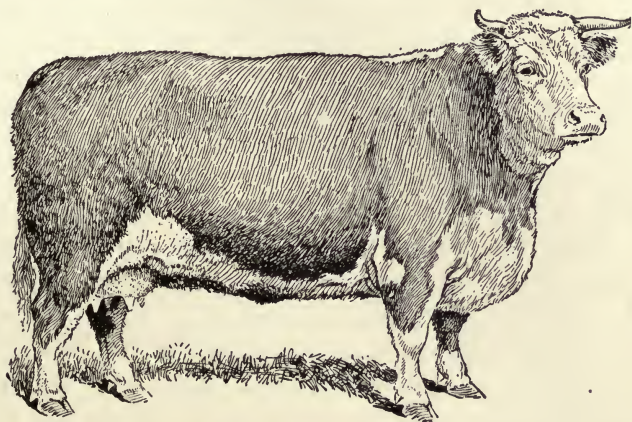


FIG. 29. — A Hereford cow, showing the conformation, color, markings, and head characteristics desirable in the breed.

Henry Clay, in 1817, became the first importer of Hereford cattle into the United States. From 1840 to 1860, a great many were brought to America. Because the Hereford cattle are superior rustlers, they have been used much in crossing with native Western cattle. Although Herefords have not been used as much in crossing on native cattle of North and South America as have the Shorthorns, it may be said that in the last decade their popularity has steadily increased, and that their good qualities are becoming realized more and more by ranchmen.

b. Characteristics. The Herefords are typical beef-producing cattle. They are not quite as large as the Shorthorn breed. The color is red, with a white head and the white extending over neck and along the underline. Six white tips may often be seen in the individuals of this breed. They have a quiet, docile disposition. In milk production they rank low and are often criticized on this point.

The distinguishing characteristics of the Herefords are, (1) prepotency, or power of transmitting definite breed characteristics, (2) early maturing qualities, and (3) grazing attributes. Where Hereford cattle have been crossed with other breeds, Hereford markings usually crop out in the offspring. Their vigorous constitution is often transmitted when crossed with other cattle. This is partly due to the fact that in spring of rib they are unequaled. Hereford cattle mature early and are, therefore, superior in economical meat production. They are good grazers, and as rustlers in stalk fields, pastures, and on the range where feed is scarce, they are unexcelled.

3. *Aberdeen Angus cattle.* *a. History.* The Aberdeen Angus originated in the counties of Aberdeen, Kincardine, and Forfar, Scotland. The first printed reference to this breed was made in 1797.

The Angus cattle were first introduced into the United States in 1873, when George Grant of Victoria, Kansas, imported three bulls. From 1875 to 1885 small numbers of Angus cattle were imported into different sections of the United States and Canada. Large numbers are found in the "corn belt" states, and they are widely distributed throughout Europe.

b. Characteristics. The Angus cattle are black, polled, and are of a typical beef conformation. They are not quite as large as the Shorthorn breed. Their bodies are more cylindrical than are the bodies of either the Shorthorn or Hereford breeds. Com-

pactness is a strong feature of the breed. In quality, which refers to desirable features of bone, skin, and hair, they are unexcelled. It is for this reason, along with their splendid conformation, that they dress out as high a percentage of carcass as any breed. The Angus cattle are good grazers and feeders and are



FIG. 30. — The Aberdeen Angus steer. An example of a fine beef type.

unsurpassed in quality of flesh produced. For beef production, meeting the market demands of the commission houses, and in show ring competition, the Angus breed ranks high.

4. *Galloways. a. History.* The Galloways came from Scotland. Their origin is more or less obscure; the name is from the province of Galloway in the southwestern part of Scotland. At

first the cattle of Galloway were horned, and not until about 1789 did "polled" cattle appear. In 1862 the Galloway Herd-book Society was organized. In America an organization to improve the Galloways was perfected under the title of "The American Galloway Cattle Breeders' Association," in 1882. The Galloways are now mainly distributed in Scotland and America.

b. Characteristics. The Galloways are black, hornless, and covered with a heavy, curly coat of hair. Hardiness and strength of constitution are characteristics of the breed. They are well adapted to a cold, rigorous climate. Because of their hardiness and rustling qualities, they are popular on the Western and Northwestern ranges. The breed has been criticized for lack of spring of rib, late maturity, and for slow response to feeding. These points are being overcome to a large extent by selective breeding.

Management of beef cattle. — The number of beef cattle per one thousand people in the United States decreased from 660 to 450 between 1900 and 1910. The reasons for this decrease are:

1. The ranges of the West are being plowed up.
2. Farmers can often get more cash out of the sale of crops.
3. Tenant farmers are often unable to stock the rented farms.
4. Growing cities have increased the demand for milk and its products.

Economic production of beef. — In producing beef more economically three points must be considered:

1. Relation of age to economic gains
2. Relation of age to cost of fattening
3. Influence of degree of finish upon gains

1. *Relation of age of cattle to economic gains.* The tabulation of the findings of the Ontario Agricultural College shows



FIG. 31. — A typical Galloway heifer. Note color, conformation, and long hair that stamp this breed.

the amount of gain in weight at different ages and the amount of food required.

RELATION OF AGE TO ECONOMIC BEEF PRODUCTION

	FIRST YEAR	SECOND YEAR	THIRD YEAR
	Pounds	Pounds	Pounds
Daily gain	2.2	1.2	1.1
Total gain	785	456	350
Feed per one hundred pound gain			
milk calf used	492		
Concentrates	159	480	689
Hay	184	777	776
Succulent feed	314	1928	2637
Digestible nutrients per one hundred pound gain	315	875	1183
Water drunk daily	27	43	47

This table shows that the first year the calf made a gain of 2.2 pounds a day; the second year, 1.2; and the third year, 1.1 pounds a day. If the feed per one hundred pound gain is studied, some interesting points are brought out. The total digestible nutrients required to produce a one hundred pound gain was 315 pounds during the first year, 875 pounds the second year, and 1183 pounds the third year. The steer weighed 1588 pounds when slaughtered.

We should not conclude from this table that it is more economical to sell the steer when he is a year old; but it should cause us to study the relation of age to economic gains. The time to sell is dependent frequently upon local or other conditions and calls for judgment.

2. *Relation of age to cost of fattening.* With 153 head of cattle, the Ottawa Experiment Farms found the results shown in the following table:

RATE AND COST OF GAINS FOR FATTENING STEERS OF VARIOUS AGES

	AVERAGE WEIGHT AT BEGINNING	AVERAGE DAILY GAIN	AVERAGE COST OF ONE HUNDRED POUND GAIN
	Pounds	Pounds	Dollars
Calves	397	1.8	\$4.22
Yearlings	833	1.6	5.31
Two-year-olds	1011	1.8	5.62
Three-year-olds . . .	1226	1.7	6.36

This table indicates that calves weighing 397 pounds put on a one hundred pound gain at a cost of \$4.22, and that it required \$6.36 worth of feed to put an equal weight on three-year-old steers, weighing 1226 pounds.

3. *Influence of the degree of finish upon gains.* The Kansas Station found the following regarding the amount of gain required to produce one hundred pounds of gain :¹

	GRAIN FOR ONE HUNDRED POUND GAIN	INCREASE OF FEED REQUIRED
Up to 56 days the steers required	730 lb. of grain	
Up to 84 days the steers required	807 lb. of grain	10%
Up to 112 days the steers required	840 lb. of grain	15%
Up to 140 days the steers required	901 lb. of grain	23%
Up to 168 days the steers required	927 lb. of grain	27%
Up to 182 days the steers required	1000 lb. of grain	37%

From these data we learn that feeders find that, as they approach the finishing period of fattening cattle for market, it is more difficult to secure gains in weight. The results of these experiments indicate that it costs heavily to fatten the steer thoroughly. The importance of selling at the earliest possible date is plain from the table.

¹ Kansas Bulletin, No. 34.

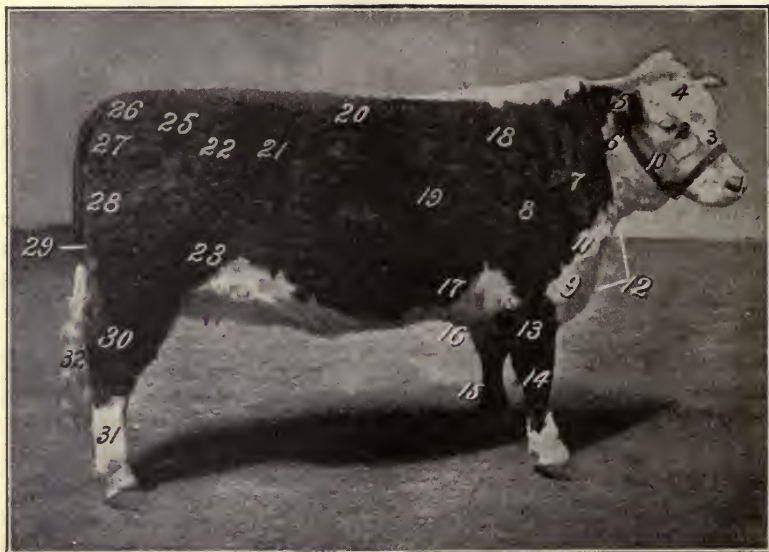


FIG. 32. — Points of the beef cow.

- | | | |
|-------------------|-----------------|-----------------|
| 1. Muzzle. | 12. Dewlap. | 23. Hind flank. |
| 2. Eye. | 13. Arm. | 25. Rump. |
| 3. Face. | 14. Shin. | 26. Tail-head. |
| 4. Forehead. | 15. Fore leg. | 27. Pin bone. |
| 5. Ear. | 16. Chest. | 28. Thigh. |
| 6. Neck. | 17. Fore flank. | 29. Twist. |
| 7. Shoulder vein. | 18. Crop. | 30. Hock. |
| 8. Shoulder. | 19. Ribs. | 31. Shank. |
| 9. Brisket. | 20. Back. | 32. Tail. |
| 10. Jaw. | 21. Loin. | |
| 11. Breast. | 22. Hip. | |

LABORATORY EXERCISES AND HOME PROJECTS

- | NAME OF FARMER | KIND OF CATTLE | NUMBER |
|----------------|----------------|--------|
| | | |

2. Locate on a live animal the beef cuts. Number them in the order of their value.
3. Score all beef breeds, if possible, according to the following score card.

BEEF CATTLE — SCORE CARD (*Continued*)

SCALE OF POINTS		PERFECT	STUDENT'S	CORRECTION	STUDENT'S	CORRECTION	STUDENT'S	CORRECTION	STUDENT'S	CORRECTION
Brisket, broad, full ; breast, wide		2								
Legs, straight, short, strong, wide										
apart ; forearm, full ; shank,										
fine ; feet, sound		2								
4. Body — 32 points										
Chest, deep, broad ; girth, large ;										
fore flank, full		4								
Crops, full, thick, even with shoul-										
ders		5								
Back, broad, straight, medium										
length ; thickly, evenly, and										
firmly fleshed		7								
Ribs, deep, well sprung, closely										
set, thickly, evenly, and firmly										
fleshed		7								
Loin, broad, straight ; thickly,										
evenly, and firmly fleshed . .		7								
Flanks, full, low		2								
5. Hind quarters — 22 points										
Hips, smoothly covered, propor-										
tionate width		3								
Rump, long, level, width well car-										
ried back ; thickly, evenly, and										
firmly fleshed		5								
Pin bones, wide apart, not promi-										
nent		1								
Tail, fine, tapering, medium										
length		1								
Thighs, deep, wide, well de-										
scended, and fleshed		4								
Twist, deep, broad, well filled .		6								
Legs, straight, short, strong ;										
shank, smooth ; feet, sound .		2								
Total		100								

4. Describe in a two hundred fifty word paper the outstanding characteristics and contrasting features of the different beef breeds.

5. Study your cattle barn, and report on the same as to the following things: (1) room, (2) dryness, (3) light, (4) ventilation, (5) cleanliness, and (6) convenience.

CHAPTER VI

DAIRY CATTLE

Importance of dairying. — According to the United States Census for 1920, there were 31,386,378 dairy cows in the United States, which produced 7,805,238,000 gallons of milk. The total value from dairy products in 1919 was \$1,481,462,000. This does not include the milk and cream used on the farms, which would approximate closely, or probably exceed, the above figure. Wing states that, in 1900, the average production per cow was 3600 pounds of milk, equivalent to about 150 pounds of butterfat. In 1920, the average milk production of the average dairy cow was about 3900 lb. according to the Census Report. This milk at \$2 per hundredweight, or 25 cents per pound butterfat, would yield \$78 or \$40 per cow respectively.

COMPARATIVE VALUE OF LIVE STOCK PRODUCTS FOR 1919

Live stock products	\$2,667,738,000
Dairy products	1,481,462,000
Chickens and eggs	1,048,000,000
Wool and mohair	124,007,000
Honey and wax	14,280,000

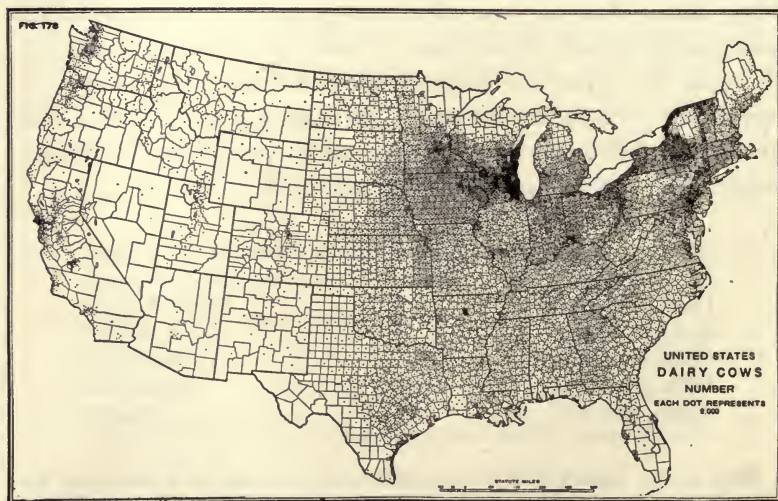
Note to the Teacher: The materials needed to do the Laboratory Exercises and Home Projects at the close of this chapter are:

Dairy cows at different times; an eight-bottle closed Babcock Tester (open testers are inaccurate and dangerous); the necessary glassware and chemicals needed to make the Babcock test; samples of whole milk and skimmed milk.

The importance of milk as a food for man can hardly be estimated, both because of its extensive use and also because it contains the food nutrients in a better proportion than any other one food. Milk is a well balanced food.

More attention will be given to dairying as the population becomes denser. The cities consume large quantities of milk and milk products. Consequently the farmers of the territory surrounding the city devote much of their time to dairying, and, where shipping facilities are good, the demand for milk is so great that it is often shipped two hundred miles or more to market.

Leading dairy states. — The beef industry has developed almost entirely upon cheap lands, where grass is abundant, and



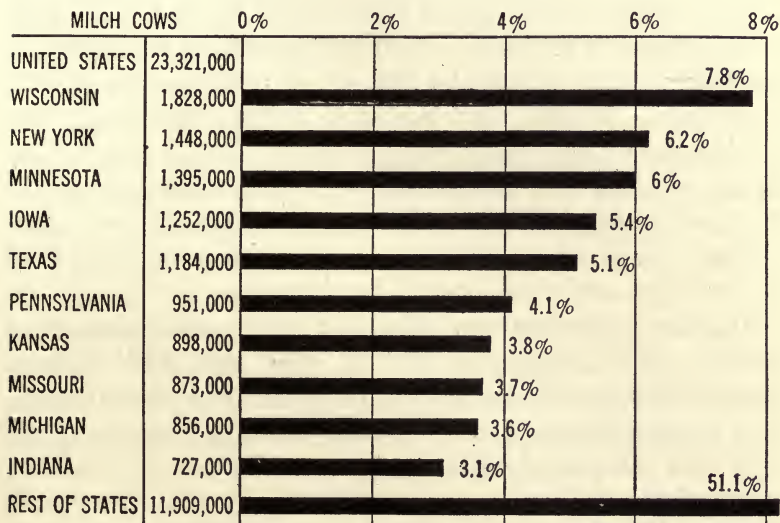
From The Geography of the World's Agriculture.

FIG. 33.

in the corn belt, where the steer can be finished for market. The dairy industry, also, depends to a considerable extent upon the

growth of grass and roughages and some concentrates. But an additional factor determining the location of the dairy industry is the market and centers of population. This is especially true where whole milk is sold. The distribution of dairy cattle is shown in the preceding map.

The ten leading dairy states in the order of the number of dairy cattle as given by the U. S. Yearbook of Agriculture (1921) are:



GRAPH 2.—The ten leading states in dairy cattle production.

The ten leading dairy states have about half of the dairy cows of the United States, — and doubtless these states have the best cows on the average, — and produce over one half of the milk and milk products of the United States.

According to 40,000 yearly records of cows tested in the United States in cow-testing associations, the average yield of milk is 5980 pounds and 246 pounds of butterfat in a year; while the

average cow in the United States produces almost 4000 pounds of milk and 160 pounds of butterfat. According to the U. S. Yearbook of Agriculture (1920) the United States holds sixth place among 14 prominent nations in the average yield of milk per dairy cow, being excelled by The Netherlands, Switzerland, Denmark, Germany, and Canada. The milk production per cow in these countries does not exceed the production in the United States on account of superior feeding, but because the cows there are carefully tested and carefully selected.

Advantages of dairying. — In thickly populated countries and near cities where land is high priced, nearly all farmers give up their land to dairying, truck gardening, and poultry raising. On the islands of Jersey and Guernsey, land is said to rent for \$60 to \$70 per acre, and in Holland, where land cannot be bought for less than \$1500 to \$2000 per acre, dairying is the main occupation. Land near our American cities valued at from \$400 to \$1000 per acre is used largely for dairying.

Dairying is advantageous because it aids in maintaining soil fertility. The average amount of solid and liquid manure voided in a year by a thousand-pound dairy cow is about 12 tons. It is stated that such manure contains fertilizing materials (plant food) the value of which is \$2.74 per ton. Upon this basis the value of the fertilizer materials voided by a cow in a year is \$32.88. However, the amount of manure voided is almost in direct proportion to the amount of milk produced; a good cow consumes more feed and hence voids more manure. It is a well-known fact that dairy farms become more productive as this type of farming is continued. When butterfat is sold from the farm, very little soil fertility is removed.

The table on the following page will give a comparison of the fertilizing constituents in feeding stuffs and animal products.

FERTILIZING CONSTITUENTS IN FEEDING STUFFS AND ANIMAL PRODUCTS ¹

	FERTILIZING CONSTITUENTS IN 2000 POUNDS			FERTILIZING VALUE PER TON
	Nitrogen	Phosphoric Acid	Potash	
Dent corn . . .	32.4 lb.	13.8 lb.	8.0 lb.	\$6.85
Wheat . . .	39.6	17.2	10.6	8.43
Timothy hay . .	19.8	6.2	27.2	5.20
Red clover hay .	41.0	7.8	32.6	9.36
Animal products				
Fat ox . . .	46.6	31.0	3.6	9.96
Fat pig . . .	35.4	13.0	2.8	7.10
Milk . . .	11.6	3.8	3.4	2.43
Butter . . .	2.4	0.8	0.8	0.57

From this table it may be observed that if a ton of butterfat is sold, only 57 cents' worth of soil fertility is removed from the farm; while if an equal amount of dent corn is sold, \$6.85 worth of soil fertility is removed.

The dairy cow, of all farm animals, is the most economical producer of human food; that is, a dairy cow produces more human food in proportion to the feed fed than any other animal.

HUMAN FOOD PRODUCED BY FARM ANIMALS FROM ONE HUNDRED POUNDS
OF DIGESTIBLE MATTER CONSUMED ²

ANIMAL	MARKET- ABLE PRODUCT, POUNDS	EDIBLE PRODUCT, POUNDS	ANIMAL	MARKET- ABLE PRODUCT, POUNDS	EDIBLE PRODUCT, POUNDS
Cow (milk) . .	139.0	18.0	Poultry (eggs)	19.6	5.1
Pig (dressed) .	25.0	15.6	Poultry (dressed)	15.6	4.2
Cow (cheese) .	14.8	9.4	Lamb (dressed)	9.6	3.2
Calf (dressed) .	36.5	8.1	Steer (dressed)	8.3	2.8
Cow (butter) .	6.4	5.4	Sheep (dressed)	7.0	2.6

¹ Henry and Morrison; "Feeds and Feeding."² Jordan; "The Feeding of Animals."

This table shows that with 100 pounds of feed the dairy cow produced 18 pounds of edible food for man; more than that produced by any other farm animal. The table deserves close study.

Eckles and Trowbridge, of the Missouri Station, have furnished the following data on the point that the cow is a very economic human food producer as compared to a beef steer.

	AVERAGES OF COWS PRODUCING 6000 POUNDS MILK	18,405 POUNDS MILK	STEER, WEIGHT 1250 POUNDS
Proteids	187	552	172
Fat	200	618	333
Sugar	300	920	
Ash	43	128	43
Total	730	2218	548

It took the dairy cow one year to produce 2218 pounds of human food, while the beef steer produced only 548 pounds in about two years. The cow producing 6000 pounds milk produces 730 pounds of edible dry matter in a year. The sugar in milk is worth as much per pound for human food as ordinary sugar.

Five essential points of a good dairy cow. — In order that the value of a dairy cow may be rightly judged, the amount of her feed should be known, her milk should be weighed and tested for butterfat. It is not always possible to decide upon these points, so we must know what characteristics to look for in a cow which show milk-producing capacity. There are five points that are essential to a good dairy cow. These are:

1. Good constitution
2. Capacity for food
3. Proper temperament
4. Good blood circulation
5. Milk-producing ability

1. *Constitution* is indicated by a strong, large girth, broad head, box-shaped muzzle, and large, well-distended nostrils. A thin-chested, narrow, long-headed animal has not a good constitution; an animal that has very small nostrils cannot take in large volumes of air, which is essential to a long life. The average economic productive period of a dairy cow is 6 to 7 years.



Courtesy of the Agricultural Extension Department, Purdue University.

FIG. 34.—Wedge shape as seen from the side.

An extraordinary milk yield for one or two years is not sufficient. A cow with a good constitution will be valuable from 2 to 5 years longer than a cow with a poor constitution.

2. If a cow is to be profitable, she must have a large *capacity for food*. Capacity for food is indicated by a large barrel and a long body. A cow with a short body and a small stomach girth measure cannot consume large quantities of food or produce much milk. A cow measuring 34 inches from withers to hips, 74 inches around

the heart girth, and 88 inches around the barrel has one and one half times the capacity that a cow has that measures 30, 65, and 75 inches, respectively, in the same points. Short-ribbed, slab-sided, short-bodied cows can consume only small amounts of feed and therefore can produce only small amounts of milk.

3. *Dairy temperament* is essential to a good dairy cow. A cow with such a temperament is angular, triple wedge-shaped, and



*Courtesy of the Agricultural Extension Department,
Purdue University.*

FIG. 35. — Wedge shape as seen from above and behind.

lacks flesh. A dairy cow that is well fleshed is not transforming enough food into milk, but is converting a lot of it into meat. This kind of cow is a beef-producing cow. The most economical milk producers are angular and skinny. They have prominent hip bones, poorly covered ribs, and well-defined vertebræ. The best milk-producing cow is triple wedge-shaped; that is, from a side view she shows less depth of body at the front than she does at the rear. Secondly, viewed from front, she shows more width at hips than she does through the breast and chest. Thirdly, as we look downward and backward over the withers,

the third wedge-shaped conformation may be seen. This type of cow is the best milk producer. This type has arisen because certain organs of the dairy cow perform more work than others.

The digestive, milk-secreting, nervous, and circulatory systems are extremely active, and are therefore greatly developed.

In selecting cows for milk production, the type of cow here described is very important. It must be remembered, however, that not all cows of this type are good milk producers. Every cow is an individual when we come to consider the amount of milk that she can be made to give. A cow of good type may be a poor milk producer, but, in general, the best milk producers are cows from the best type. Profitable dairying requires, first, that cows of the right type be selected, and second, that every cow be tested to find out her milk-producing capacity. If, then, the cows that produce little are disposed of, a good producing herd can be secured.

To show the relation of dairy temperament and dairy form to economy of milk production, Haecker of the University of Minnesota divided cows into four groups according to type. The returns of different types are given in the table on page 96.

This table will afford a very profitable study, and its lesson should be applied in the development of the dairy herd. Economy in production is the surest way of increasing dividends, and such savings often make the difference between success and failure.



Courtesy of the Agricultural Department, Purdue University.

FIG. 36. — Wedge shape as seen from the front.

ECONOMY OF MILK PRODUCTION OF DAIRY AND BEEF TYPES

TYPES	NUMBER OF ANIMALS	AVERAGE LIVE WEIGHT	DRY MATTER CONSUMED			FEED COST OF POUND FAT
			Daily	Daily per 1000 Pounds Live Wt.	Per Pound Fat	
		Pounds	Pounds	Pounds	Pounds	Cents
Beef type . . .	3	1240	20.8	16.7	31.3	17.5
Less beef type .	4	945	20.4	21.0	26.4	15.1
Spare, but lacking depth of body . . .	3	875	20.0	23.0	25.5	14.6
Dairy type . . .	12	951	21.9	23.6	21.2	12.1

It will be observed that the cows of a beef type and beef temperament produced butterfat at a cost of 17.5 cents per pound,

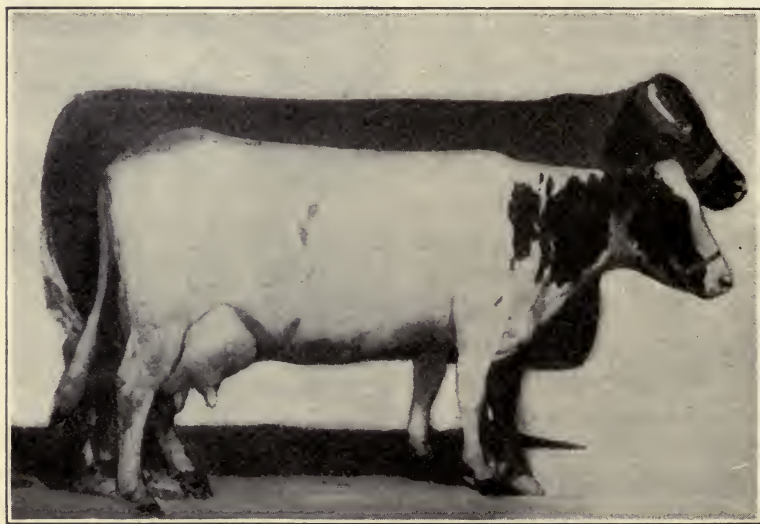


FIG. 37.— Beef and dairy type in outline. Compare their conformation and function.

and that the dairy type produced an equal amount of butterfat at a cost of 12.1 cents per pound. All similar tests add their

testimony to the often emphasized fact that type and temperament play a large part in production.

4. *Circulation.* Just how the cow digests food and converts it into milk is a topic too complicated to present here. Food must be transformed and conveyed by the digestive and circulatory systems before milk can be produced. "Good blood cir-



FIG. 38. — Examples of well-developed milk veins.

culation is shown by a network of veins on the udder; and by the size and number of the milk wells or holes in the abdomen through which these blood vessels pass, carrying the blood on its return to the lungs to be purified and to be pumped back again. Large milk wells also indicate good blood circulation.

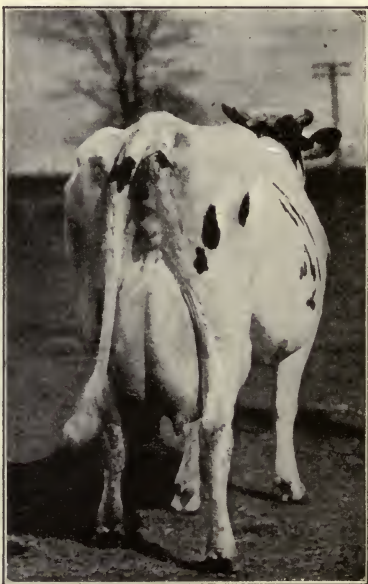


FIG. 39. — Example of well-formed udders. Note network of veins.

“Cows with small, short, straight milk veins, and only two small wells, show either that the blood circulation is small and sluggish, or that the nutrients are being conveyed to some other part of the body to be converted into some product other than milk and butterfat.”

5. Two factors which are essential to *milk-producing ability* are the proper form and texture of the udder. The udder should be large, wide, long, and fairly deep, but well held up, extending well up between the thighs and well to the front. An udder that lacks width and length but is deep is not well formed. It should be evenly quartered and symmetrical; the teats should be of proper size, and evenly and well placed.

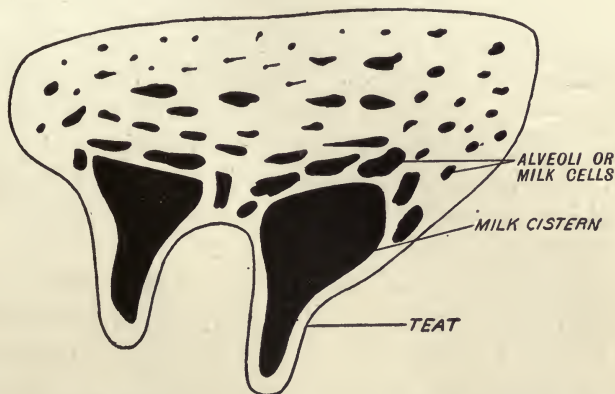


FIG. 40.—A cross section of a cow's udder, showing the milk cistern and milk cells. The size and number of openings in the udder determine its texture.

The udder is supposed to manufacture all the constituents in milk except water. Butterfat, casein, and sugar are all formed in the udder. It must have, therefore, a great deal of interior milk-producing surface. There must be large milk cisterns, and a large number of milk cells, as indicated in the above figure. When these milk cisterns and milk cells are large and numerous, thousands in number, the empty udder is soft, pliable, elastic, and collapsed. It has great capacity for work and expansion during the production of the milk. Hard, beefy udders have small milk cisterns, few and small milk cells, and their shape after milking is nearly the same as before.

Constitution, capacity, temperament, circulation, and ability — these are, first of all, essential to milk production. Other points of equal importance, such as feeding, care and management, cost to produce milk, housing, and aids to the highest milk production are discussed in later paragraphs.

Major dairy breeds. — The major dairy breeds are the Jerseys, Guernseys, Holstein-Friesians, and Ayrshires.

1. *Jerseys.* a. *Origin and history.* The Jersey cattle are native to the Channel Islands, which are in the English Channel between England and France. Although the Jersey breed traces back many years, their real history dates back from about 1763 to 1789. Since then their purity as a breed has been protected by law. In 1789, an act was passed that no cattle could be imported into the island of Jersey unless they were to be slaughtered within 24 hours after their arrival.

The island of Jersey is about 11 miles long and averages 4 miles wide, and contains about 28,717 acres. From ten to twelve thousand cattle are kept upon it, however, or about one cow to every 2.4 acres of land.

In 1850, some Jersey cows were brought to Hartford, Connecticut. Since then many Jerseys have been imported into the United States, and now they are the most popular of all the dairy breeds because of their efficiency in producing rich milk, and because the American Jersey Cattle Club has advertised the good points of the breed. Large dairies of Jersey cattle are found in the United States, France, Canada, England, and Australia.

b. *Characteristics.* The Jersey is the smallest of the main dairy breeds, weighing from 850 to 1000 pounds. They are fawn-like in color, with occasional white spots. The muzzle, tongue, and switch are generally black. They are usually considered the best dairy type, being angular and wedge-shaped. Their dairy temperament is, with few exceptions, typical of a perfect



FIG. 41. — A pure bred Jersey cow. A good example of the Jersey type in conformation, type, and color.

dairy cow. This is shown by the fact that the Jersey seldom becomes fleshy when producing milk, for all of the food consumed is transformed into milk. The Jerseys, as a breed, are more sensitive and nervous than other breeds. When properly handled they become gentle, but when any unusual thing happens they are easily frightened. If Jerseys are not accustomed to them, children may endanger their lives by going into a lot where there are Jersey cattle.

The Jersey is a poor producer of beef. Their ability to make gains is comparatively low, and their ability to dress out a high per cent of carcass is still less.

c. Dairy characteristics. The Jersey breed is not the most economical producer of quantity of milk. But they will produce more butterfat with the same amount of feed than any other breed. From a large number of butterfat tests, the following averages have been found for the breeds named : ¹

	SOLIDS	BUTTERFAT TEST
1. Jersey	14.70	5.6
2. Guernsey	14.71	5.3
3. Devon	14.50	4.6
4. Shorthorn	13.38	4.4
5. Ayrshire	12.61	3.6
6. Holstein-Friesian	11.85	3.4

Jersey milk is rich, of a deep yellow color, with large butterfat globules. Milk with large butterfat globules creams easily.

The Jersey is a persistent milker and as a family cow it has scarcely an equal. A few yearly records of the leading Jerseys follow :

¹ Cornell Experiment Station.

NAME OF COW	POUNDS MILK	POUNDS BUTTERFAT
Sophie 19th of Hood Farm . . .	17,557	999
Spermfield Owl's Eva	16,457	993
Eminent's Bess	18,782	962
Jacoba Irene	17,253	952

2. *Guernseys. a. Origin and history.* The Guernsey cattle were developed on the island of Guernsey, another of the Channel Islands group just off the coast of France in the English Channel. The island of Guernsey is about nine and one half miles long and averages in width nearly 3 miles, and contains about 15,750 acres. Upon this island are kept 5000 to 8000 cattle.

It is stated upon good authority that one hundred years ago the Guernseys and the Jerseys were almost the same in color and size. The purity of the Guernsey, like that of the Jersey breed is now protected by law.

Guernsey cattle were not introduced into the United States in large numbers until 1880. To-day the Guernseys are found extensively in New York, Massachusetts, Wisconsin, Pennsylvania, and some of the other leading dairy states.

Although the Guernseys have been widely distributed, they are found only in small numbers in the United States, England, and Canada. Plumb says in his book, "Types and Breeds of Farm Animals," that it has never been clear to him why the Guernseys have not attracted more attention in the United States. "It is a dairy breed of the highest merit, as repeated tests have shown; yet it is quite limited in development and does not seem to get much foothold in some of our greatest dairy states, especially in the Mississippi Valley."

b. Characteristics. In general appearance the cattle of this breed are about 100 pounds larger than the Jerseys, have coarser



FIG. 42. — Pure bred Guernsey cow. Record, 18,458 pounds milk, 907 pounds fat, in one year as a four-year-old.

bones and features, and are nearly perfect in dairy type. Their color ranges from an orange to a lemon fawn, with white markings. The udder of the Guernsey is somewhat larger than that of the Jersey, is well held up, and extends further to the front. The skin secretions are very yellow.

The cattle of this breed are slower and not so nervous, excitable, and irritable in temperament as the Jerseys.

c. Dairy characteristics. The Guernsey cattle are persistent milkers, and in quality of milk produced they rank a close second to the Jerseys. Their milk is very yellow and has large fat globules. The butter made from Guernsey milk is very yellow.

The records of a few leading Guernsey cows follow :

NAME OF COW	POUNDS OF MILK	POUNDS BUTTERFAT
Murne Cowan	24,008.0	1098.18
May Rilma	19,673.0	1073.41
Spotswood Daisy Pearl . . .	18,602.0	957.38

3. *Holstein-Friesians.* *a. Origin and history.* The native home of the Holstein cattle, as they are usually called in the United States, is Holland, in the province of Friesland. For over 2000 years they have been bred there, and are therefore the oldest breed of cattle. From the ninth century to the present day, Holland has been a great producer and exporter of milk, butter, and cheese.

A few Holstein cattle were imported into New York as early as 1795. They were not imported in large numbers until 1861. In 1873 the first Holstein Association was formed, known as the Holstein Herd Book Association, and in 1879 the Dutch Friesian Association was formed. These two were fused in 1885 under the name Holstein-Friesian. Although the Jersey breed was intro-



FIG. 43. — Pure bred Holstein cow, "Missouri Chief Josephine." Record, 26,861 pounds of milk, 741 pounds of butterfat in one year. A fine specimen of the Holstein breed.

duced into the United States first and enthusiastically advertised, the Holstein cattle are at present largely used in the leading dairy states ; namely, Wisconsin, New York, Pennsylvania, Michigan, Illinois, Missouri, and Ohio.

b. Characteristics. In general appearance the Holstein cattle are not so typically a dairy form as are the Jerseys, but approach slightly the beef type. They are the largest dairy breed, males weighing from 1800 to 2000 pounds and females from 1200 to 1600. There has been and is a tendency toward the development of Holstein cattle resembling the dairy type. This has been due largely to the opinions of judges passed on Holstein cattle at fairs. The color is black and white, varying in different localities. American breeders generally prefer cows with more than one half white. The udder of the Holsteins is large, U-shaped, and usually very deep but not extended. The Holstein cattle are docile, gentle, and easily handled.

c. Dairy characteristics. The Holstein cattle, as a breed, produce quantity of milk more economically than do the cows of any other breed ; that is, with a given amount of feed they will produce more milk than any other cattle. The milk of the Holstein cattle is lighter in color, and contains less fat than the milk of other breeds of cattle. The small butterfat globules in Holstein milk do not rise to the top as easily nor as rapidly as the large butterfat particles in Jersey and Guernsey milk. It is for this reason that milk from Holstein cows sustains a greater loss of butterfat in the skim milk than the milk from other breeds, especially where the gravity system of separating is used. Machine separation is usually efficient even if the fat globules are small.

Since the butterfat from the Holstein is lighter in color than that of the Jerseys and Guernseys, the cream and butterfat from this breed is also lighter. Some people think that a light-colored

butter is not rich and will not pay so high a price for it as for darker butters. Holstein cattle, because of the large quantity of milk produced and also because the fats and the solids not fat

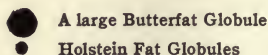


FIG. 44. — Showing the comparative sizes of small and large fat globules. Fat globules range from $\frac{1}{25,000}$ to $\frac{1}{1,500}$ inch in diameter.

are well balanced, are well adapted to the condition in which milk is retained to the consumer. Holstein milk is easily digested because the butterfat globules are small and expose more surface to the digestive fluids. Holstein milk is better suited for children's use than the milk

produced by other cattle, for the reasons that the butterfat particles are smaller on the whole, and the total solids in the milk are usually less, making the milk easily digestible. The popularity of Holstein milk is increasing, especially where whole milk is wanted for family use.

d. Methods of handling dairy cattle in Holland. Much of the country of Holland is below the level of the sea, which is held back by extensive dikes and embankments. The land is well drained and very fertile; although it is seldom sold, it is valued at from \$1200 to \$2000 per acre. The fertile soil of Holland produces a luxuriant growth of grass and hay, on which the cattle graze from May to October. The people of Holland very rarely feed grain to their cattle. This diet of grass and little grain is probably the reason why Holstein cattle give such a large quantity of milk, and why the cream is not so rich in butterfat.

From October to May the cows are kept in a stable adjoining the house, from which doors lead into the stalls. This is the reason that Holstein cattle are so gentle. The stables are kept very clean and sanitary. In summer the cows are not driven home to be milked, but are milked in the pasture, so that the cow will not grow tired. The people of Holland were the first to

form associations to test the producing power of cows and to set a standard.

e. Advanced Registry Official (A. R. O.). The Babcock test was invented about 1890 in Wisconsin. New York was the first to make practical use of it. The people of New York began to organize cow-testing associations in 1894 and set up the following minimum requirements for advanced registry for Holstein cows :

2-year-old cow must produce 7.2 pounds fat in 7 days

3-year-old cow must produce 8.8 pounds fat in 7 days

4-year-old cow must produce 10.4 pounds fat in 7 days

5-year-old cow must produce 12.0 pounds fat in 7 days

The above tests were made by qualified men sent out from the experiment stations. Although the test extended only over seven days, it paved the way for the formation of the best types of cow-testing associations in which the tests are made over the entire lactation period.¹

To sum up, Holstein cows have a vigorous constitution, quiet

¹ The butterfat requirements for the major dairy breeds for A. R. O. are as follows :

Age	JERSEY, GUERNSEY, AND HOLSTEIN		AYRSHIRE		BROWN SWISS	
	Fat	Per cent	Fat	Per cent	Fat	Per cent
Two . . .	250.5	70	214.3	66	222.0	66
Three . . .	287.0	80	236.0	73	238.4	70
Four . . .	323.5	90	279.0	87	271.4	80
Five . . .	360.0	100	322.0	100	304.1	90
Six . . .					337.0	100

The per cent indicates what amount of fat may be expected from a cow during any year of the milking period.

temperament, produce an abundance of milk, are free from disease, and have a good family history.

The records of a few leading Holstein cows follow:

NAME OF COW	POUNDS MILK	POUNDS BUTTERFAT
Duchess Skylark Ormsby	27,761	1205
Finderne Pride Johanna Rue . .	28,403	1176
Pontiac Clothilde De Kol	25,318	1017
Colantha 4th's Johanna	27,432	998

4. *Ayrshires. a. Origin and history.* This breed of Scotch dairy cattle was developed in the county of Ayrshire, Scotland.

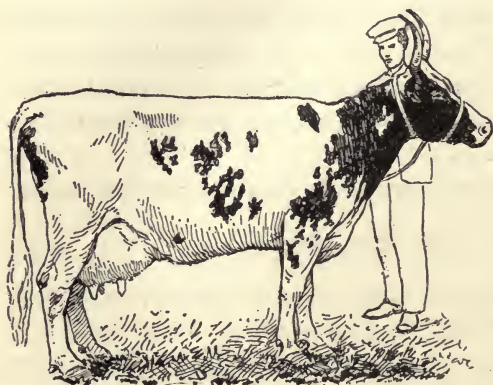


FIG. 45. — An Ayrshire cow, showing the conformation, red and white color, upturning horns, and well-formed udder that stamp this breed.

Although the Ayrshire cattle were mentioned in Scottish literature as early as 1750, not until about 1825 to 1850 did the breed assume definite characteristics. Holsteins, Durhams, and Jerseys were used as the foundation sources of this breed. Ayrshires were imported into the United States

as early as 1822, but on account of small teats their popularity decreased, and the breed was soon lost. Within recent years a considerable number have been imported, but because of the fact that they were not advertised they have not been extensively used.

The Ayrshires are mainly distributed in Scotland, Canada, Australia, the United States, Russia, Norway, and Sweden. They are better adapted than other breeds to severe climates, scant feed, and rough land, and are, therefore, generally found in such places. In the United States they are found in New England and the Ozark Plateau.

b. Characteristics. Ayrshire cattle are red, brown, and white in color. They are much larger than the Jerseys but smaller than the Holsteins. They are good milkers, but do not produce as much milk as the Holsteins, nor as rich milk as the Jerseys. It is largely because of their failure to excel in one of these two points that the popularity of the Ayrshires has not been greater. The horns of this breed turn outward and upward and are white with black tips. Their udders are uniform and almost perfect. They are well held up, are wide, and extend well forward on the body. Plumb states that the udder development of the modern Ayrshires presents a higher average perfection of form than does that of any other breed. Their temperament is good.

The milk of Ayrshire cattle contains a great deal of casein. In their native home in Ayrshire the milk is used almost entirely in the manufacture of cheese.

The leading records of the Ayrshires up to the present are as follows :

NAME	POUNDS MILK	POUNDS BUTTERFAT
Auchenbrain Brown Kate 4th . .	23,022	918
Garclaugh May Mischief	25,328	897
Lily of Willowmoor	22,106	889
Auchenbrain Yellow Kate 3d . .	12,123	888

The cost of milk production. — It is impossible to handle this large topic exhaustively in this small treatment. The discussion

here is merely suggestive. Some further points may be worked out by teacher, pupil, and farmer.

Large production lowers the cost. — A cow that yields 3900 pounds of milk per year does not produce milk as cheaply as a cow that produces 10,000 pounds per year. The first figure given is approximately the average production of the dairy cows of the United States.

COST OF MILK FROM COWS PRODUCING DIFFERENT AMOUNTS

POUNDS MILK PER YEAR	COST TO PRODUCE 100 POUNDS OF MILK	COST OF PRODUCING A QUART OF MILK
3,000	\$1.70	3.3 cts.
4,000	1.25	2.5
5,000	1.00	2.0
6,000	.83	1.7
7,000	.71	1.3
8,000	.62	1.2
9,000	.55	1.1
10,000	.50	1.0

The assumption that it costs \$50 to keep a dairy cow for one year is the basis of the foregoing table. We have learned that the dairy type of cow produces milk at less cost than the beef type. The dairy cow is angular, showing that she transforms nearly all the food she eats into milk; the beef cow is fat, showing that she transforms all her food into fat. The cost of milk production is from 25 to 30 per cent less from dairy types than from beef types.

Cows freshening in the fall produce milk more cheaply. — It is a well-known fact that cows freshening in the fall produce from 25 to 35 pounds of butterfat more per year than cows freshening in the springtime. This is because the cow has two periods,

one in the fall and another in the spring, when the milk flow is large. The increase in butterfat is equal to an increase of from 600 to 800 pounds of milk. This is approximately from one sixth to one fifth of the total production. Therefore, if it costs \$50 to keep a cow for one year, the cost of milk production will be decreased from about 16 to 20 per cent by cows calving in the fall.

Production covering a long number of years lessens the cost of milk production. — The cost of producing calves and heifers until they are 24 months old has been found, by Bennett and Cooper of Wisconsin, with 117 calves, to be as follows :

COST OF REARING DAIRY HEIFERS IN WISCONSIN¹

	COST TO ONE YEAR	COST TO TWO YEARS
1. Initial value of calf . . .	\$ 7.04	\$ 7.04
2. Feed	24.67	40.83
3. Labor	4.45	7.81
4. Other costs	6.36	13.73
Gross cost	\$42.52	\$69.41
Credit for manure . . .	3.00	8.00
Net cost	\$39.52	\$61.41

A cow giving milk only from the time she is 24 to 36 months old would have to produce an extremely large quantity of milk to pay for the cost of raising the heifer, and the cost of keeping the cow during the first years of milk production. But the production of milk over a long number of years reduces the cost of milk production per year. The following table shows twelve years of profitable milk production :

¹ Henry and Morrison; "Feeds and Feeding."

RECORD OF CYLENE JEWEL (UNIVERSITY OF MINNESOTA COW)¹

YEAR	MILK	BUTTERFAT TEST	BUTTERFAT	LACTATION PERIOD
	Pounds		Pounds	Weeks
1902-03	6,413.6	3.28	210.24	55
1904-05	6,231.3	3.16	197.20	52
1905-06	8,061.9	3.21	258.86	42
1906-07	7,373.9	3.31	244.33	44
1907-08	11,067.8	3.24	358.59	52
1908-09	7,487.3	2.99	224.25	42
1909-10	11,853.8	2.93	346.99	51
1910-11	11,436.0	3.28	375.39	55
1911-12	12,704.7	3.16	402.05	46
1912-13	10,713.1	3.02	323.06	46
1913-14	12,697.9	3.93	499.63	44
1914-15	12,811.1	2.89	370.09	55
Total	118,852.4	38.40	3810.68	584
Average	9,904.364	3.20	317.556	48.66

Keeping accurate records such as the above does more to put dairying on a sound basis than any other one thing.

Treating with kindness, being regular in feeding a balanced ration, providing good, clean, sanitary quarters, supplying plenty of clean, pure, medium-warm water, and allowing the cow a reasonable amount of exercise, raising the calves on skim milk, — all aid in the economical production of milk.

Composition of milk and its products. — As we have said before, milk is of such a composition that it can nourish all tissues of the body more nearly than any other food. For this reason it is the only food for many young animals for about the first eight months. The tissues of the body are made up of water, mineral matter, fatty tissue, and protein tissue. These are all

¹ Courtesy of University of Minnesota.

found in milk in such proportion that every tissue of the entire body may be well nourished. There is no other single food that will sustain life longer. The composition of other foods may well be compared with that of milk, for milk gives a good basis on which the value of other foods may be estimated.

THE AVERAGE COMPOSITION OF MILK

1. Water	87.4 per cent
2. Fat	3.7 per cent
3. Casein and albumen	3.2 per cent
4. Milk sugar	5.0 per cent
5. Ash	<u>0.7 per cent</u>
Total	100.0 per cent

According to a Federal law, milk must contain 8.5 per cent of solids not fat, and 3.25 per cent or more fat.

In order that milk may be of the best quality it must be produced by healthy cows under sanitary conditions. The cow, the surroundings, the utensils, and the milker must all be free from dirt and disease. Bacterial life in milk may be destroyed by pasteurization. The germs of tuberculosis, diphtheria, and scarlet fever may be destroyed in this way, also, but it is much better to produce pure milk.

In the modern creamery, milk is skimmed with separators. The skim milk remaining contains all the constituents given in the table excepting the butterfat. Under farm methods of skimming about 0.3 to 0.6 per cent butterfat remains in the skim milk. What is the value of skim milk? W. D. Hoard, editor of *Hoard's Dairyman*, says: "It is well established that one hundred pounds of skim milk will make 5 pounds of growth when fed to pigs weighing from 75 to 150 pounds. Multiply this growth by the price of pork and you have the minimum value of the

skim milk. Feed it in conjunction with corn and you add 20 per cent to its value or cash return, all as a result of the combination."¹

Cream is the part of whole milk which contains a larger proportion of butterfat than the whole milk. According to Federal law, cream must contain not less than 18 per cent of butterfat. Butterfat rises to the top because it is lighter than whole milk. The specific gravity of whole milk is 1.029 to 1.033; water, 1.00; and butterfat, about 0.93.

The amount of cream lost depends upon the system used in skimming. In the shallow pan system, about 20 per cent of the cream is lost. The skimmed milk retains about 0.5 of one per cent of the fat in the whole milk. In the deep-setting system where deep cans are used, only about 0.2 to 0.3 of one per cent of the fat is lost. By the use of centrifugal separators, almost all of the butterfat is taken out of the milk. However, when the skim milk is tested for butterfat, from 0.02 to 0.5 per cent of butterfat is usually found; sometimes more. Butter has about the following composition:

Butterfat	80 to 88 per cent
Salt	1 to 4 per cent
Water	10 to 16 per cent

Federal law provides that the maximum quantity of moisture in butter cannot exceed 16 per cent. Ordinarily butter has about 82½ per cent butterfat, 14½ per cent moisture, and about 2 to 3 per cent salt. By an act of Congress, May 9, 1902, butter may contain added coloring matter. The best churning temperature ranges from 50° to 60° Fahr. The extreme temperatures for churning are from 46° to 80° Fahr.

A hundred pounds of butterfat will yield about 110 to 120

¹ Wisconsin Buttermakers' Association Report of 1912.

pounds of butter, because of the addition of salt and water. The number of pounds of butter yielded above the number of pounds of butterfat is known as the *overrun*. It is upon the overrun that the creamery man depends mainly for his profits.

The composition of cheese varies a great deal, but the average for full milk is about as follows: water, 34 per cent; fat, 35 per cent; casein, 28 per cent; and salt, 3 per cent. Cheese is an exceedingly nutritious food. Butter excels cheese in flavor, but cheese is a better balanced food.

The product remaining after the fat and the casein have been taken out of milk is whey. It, also, has some food value for animals.

Feeding for milk production. — One of the great problems for the dairyman to solve is the question of converting vegetable feeds into milk. To do this best, he must know the composition of the dairy cow's body, the milk she is to produce, and the digestible composition of feeding stuffs. The price of feeds is an important factor in the economical aspect of milk production. These points can be discussed only in a brief way.

Composition of the dairy cow's body, and of the milk produced. — The author was unable to find any statement as to the chemical composition of the dairy cow's body. The composition of a half-fat steer will provide, however, a fair estimate of the approximate composition of the dairy cow's body.

COMPOSITION OF HALF-FAT STEER AND MILK

	WATER	FAT	CARBOHY- DRATES	PROTEIN	N. R.
Fat steer . . .	54.0	22.6	0.0	17.8	1 : 1.2
Milk . . .	87.4	3.7	8.7	3.2	1 : 5.3

In the production of milk, the body of the dairy cow must be first supported; then, in addition, food must be provided to produce the milk given. The food, if it is to produce the best results, must contain in proper proportions the same constituents that are found in the dairy cow's body and in her milk. It is for this reason that an abundance of water, some carbohydrates, and protein must be fed in order to get the best results from a dairy cow.

A gallon of milk weighs 8.54 pounds. It contains the following nutrients, which make it such a fine well-balanced food: water, 7.5 lb.; butterfat, $\frac{1}{3}$ lb.; sugar, $\frac{2}{3}$ lb.; casein, $\frac{1}{4}$ lb.; albumen, 1 oz.; and ash ingredients in the following amounts: lime, $\frac{1}{4}$ oz.; phosphorus, $\frac{1}{3}$ oz.; potassium, $\frac{1}{4}$ oz.; sodium, $\frac{1}{8}$ oz.; iron, $\frac{1}{500}$ oz.; chlorine, $\frac{1}{8}$ oz.; sulphur, a trace; and vitamins. Milk contains everything the body needs.

In feeding dairy cows, or the human body, such ingredients must be provided in the feed as are to be found in the product produced. Thus everything which appears in milk must first be found in the feed. If it is not found in the feed, it is certain never to appear in the product. In fact production is at once reduced when certain ingredients found in milk are not fed.

Spring conditions make most milk. Why? — Every farmer welcomes spring. The temperature, the abundance of succulent grass, the moderate exercise, the comfortable surroundings, and the balanced ration, and the drinking of a lot of clean, pure water, — all are conducive to the highest efficiency in milk production. There is nothing superior to blue grass, mixed with white clover, for milk production, because the cattle eat an abundance of this feed; it is palatable and contains the food elements which make it a well-balanced ration. Compare the composition of blue grass and white clover with the dairy cow's body and her milk.

COMPOSITION OF BLUE GRASS AND WHITE CLOVER

	WATER	FAT	CARBOHYDRATES	PROTEIN	N. R.
Blue grass . .	68.4	0.6	14.8	2.3	1 : 7.0
White clover .	78.2	0.5	9.6	3.1	1 : 3.5

It is quite probable that a small amount of concentrates fed along with the blue grass and white clover would increase the milk flow, but not the economical production of milk, except in case of short pastures. In addition to the pasture grass, an abundance of pure, clean, moderately warm water should be provided. These summer conditions are conducive to the highest milk production.

Winter feeding for milk production. — To produce the best milk in winter, summer conditions should be maintained as nearly as possible. The cows should be given an abundance of green, or nearly green, feed, a well-balanced ration, an abundance of water, and comfortable surroundings.

Well-kept silage, sugar beets, and mangel-wurzels furnish a feed that corresponds as nearly as possible to green feed. Silage is one of the principal feeds used by dairymen. Silage gives bulk to the feed, is palatable, causes the cow to eat and drink more, and is probably the cheapest substitute for green feed. Silage, however, is not a balanced feed, because it contains too large an amount of carbohydrates and too small an amount of protein.

COMPOSITION OF CORN SILAGE (FROM WELL-MATURED CORN)

	DRY MATTER	WATER	FAT	CARBOHYDRATES	PROTEIN	N. R.
Silage . .	26.3	73.7	0.7	15.0	1.1	1 : 15.1

The nutritive ratio of corn silage is as 1 : 15.1. This shows that it contains too much carbohydrate material in proportion to the protein content. The nutritive ratio of blue grass is 1 : 7.0. An equal amount of white clover and blue grass makes an excellent ration for a dairy cow. Its nutritive ratio is right, but the nutritive ratio of corn silage, 1 : 15.1, is too wide.

Bran, red clover, alfalfa, soybean hay, cowpea hay, or cottonseed meal may be used to supply the deficiency of protein in the corn silage.

DIGESTIBLE COMPOSITION OF CORN SILAGE AND OTHER FEEDS RICHER IN PROTEIN

	DRY MATTER	WATER	FAT	CARBOHY- DRATES	PROTEIN	N. R.
Silage . . .	26.3	73.7	0.7	15.0	1.1	1 : 15.1
Wheat bran .	89.9	10.1	3.0	41.6	12.5	1 : 3.9
Alfalfa . . .	91.4	8.6	0.9	39.0	10.6	1 : 3.9
Cowpea hay .	90.3	9.7	1.0	33.7	13.1	1 : 2.7
Prime cotton- seed meal .	92.2	7.8	7.9	24.3	33.4	1 : 1.3

It will be seen that the above feeds contain a large amount of protein material. It is this which helps in balancing corn silage as a ration.

The suggestions of a few practical rations will be in order here. For a cow weighing 1000 pounds, producing 25 pounds of milk, testing 4 per cent butterfat, the following rations may be used. If the farmer has not all the feeds suggested, other feeds may be supplied that will furnish the same food constituents. But in the interests of economy the farmer should always utilize feed stuffs that he has raised rather than buy in the market, and at the same time he should seek a proper combination of them.

DIGESTIBLE COMPOSITION OF A RATION¹

	PARTS OF 100 POUNDS OF EACH	DRY MATTER	FAT	CARBOHY- DRATES	PROTEIN	N. R.
		Pounds	Pounds	Pounds	Pounds	
Corn silage 25 lb. . .	$\frac{1}{4}$ of 100 lb.	6.6	.02	3.75	.27	
Clover hay 10 lb. . .	$\frac{1}{10}$ of 100 lb.	8.7	.18	3.93	.76	
Corn 4 lb. . .	$\frac{2}{5}$ of 100 lb.	3.98	.18	2.68	.30	
Bran 4 lb. . .	$\frac{2}{5}$ of 100 lb.	3.99	.12	1.68	.50	
Totals		23.27	.50	12.04	1.83	1 : 7.3
Requirements		30.00	.65	13.00	2.80	1 : 5.3

From the above it may be concluded that the ration suggested is too low in all of its constituents and that dry matter and protein are especially lacking. The nutritive ratio of the ration is too wide, indicating that a larger amount of protein should be fed.

A few other good dairy rations are given :

{ Corn silage 30 lb.	{ Corn silage 30 lb.
{ Bran 10 lb.	{ Alfalfa 11 lb.
{ Cottonseed meal 2 lb.	{ Cottonseed meal 2 lb.
{ Corn silage 30 lb.	
{ Soybean hay 10 lb.	N. R. 1 : 5.7
{ Bran 10 lb.	

¹ When production of milk is considered, regardless of cost, the composition of the ration fed should be right. But when the production is considered from an economical viewpoint, and this is the practical viewpoint, the cost of the feeds making the ration should be carefully figured.

The following method of figuring the price (not the feeding value) of feeds may be suggestive. Current prices should be used in figuring the cost of rations.

¹ Henry and Morrison; "Feeds and Feeding."

PRICES OF A FEW FEEDS

FEED	ESTIMATED COST P. R TON	COST PER 1000 POUNDS	COST PER 100 POUNDS	COST PER POUND
Corn silage . . .	\$ 3.50	\$ 1.75	\$0.175	\$0.00175
Clover hay . . .	13.50	6.75	0.675	0.00675
Cottonseed meal .	30.00	15.00	1.50	0.015
Bran	22.00	11.00	1.10	0.011

Summary. — Dairying is one of our most important farm operations. It is adaptable to high-priced land, enriches the soil, and brings a steady income. The dairy cow is the most economical producer of human food. The Jerseys, Guernseys, Holsteins, and Ayrshires are the major dairy breeds. Every cow must have a good constitution, a good temperament, a good circulation, and milk-producing capacity if she is to be a profitable cow.

A balanced ration at the lowest cost is essential to economic milk production. Conditions similar to those in summer, such as an abundance of palatable, green, well-balanced feed, an agreeable temperature, a moderate amount of exercise, and much water, are conducive to the highest milk production.

LABORATORY EXERCISES AND HOME PROJECTS

1. Make a survey of the dairy cattle of the school district. Fill out a table somewhat as follows. Leave a permanent record in the school. Assign three or four days before the results are to be reported.

NAME OF OWNER	BREED	NUMBER OF COWS	DAILY GAL- LONS MILK	POUNDS OF MILK (MUL- TIPLY GAL. BY 8.54) ¹

¹ A gallon of milk weighs 8.54 pounds.

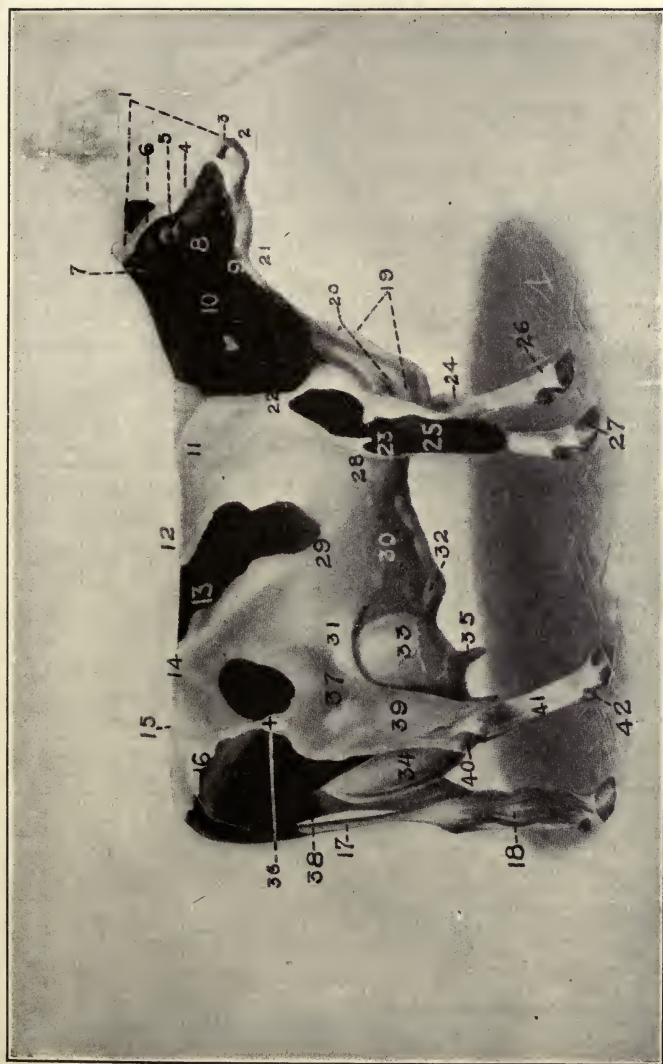


FIG. 46. — Diagram showing points of the cow.

- | | | | | | |
|--------------|---------------|------------------|------------------|---------------------|--------------------|
| 1. Head. | 8. Cheek. | 15. Pelvic arch. | 22. Shoulder. | 29. Side or barrel. | 36. Upper thigh. |
| 2. Muzzle. | 9. Throat. | 16. Rump. | 23. Elbow. | 30. Belly. | 37. Stifle. |
| 3. Nostril. | 10. Neck. | 17. Tail. | 24. Knee. | 31. Flank. | 38. Twist. |
| 4. Face. | 11. Withers. | 18. Switch. | 25. Forearm. | 32. Milk vein. | 39. Leg or gaskin. |
| 5. Eye. | 12. Chest. | 19. Chest. | 26. Ankle. | 33. Fore udder. | 40. Hock. |
| 6. Forehead. | 13. Loins. | 20. Brisket. | 27. Hoof. | 34. Hind udder. | 41. Shank. |
| 7. Ear. | 14. Hip bone. | 21. Dewlap. | 28. Heart girth. | 35. Teats. | 42. Dew claw. |

DAIRY CATTLE — SCORE CARD

SCALE OF POINTS	SCORE — FEMALE							
	Perfect Score	Student's	Corrected	Student's	Corrected	Student's	Corrected	Student's
A. General appearance — 22 points								
Weight, estimated . . . lb.; actual . . . lb.	1							
Form, wedge shape from front, side, and top	9							
Quality, hair fine, silky; skin mellow, loose, medium, thick, yellow, not fleshy; bone fine	6							
Dairy temperament, angular, not fat, totally inclined to transform food into milk . .	4							
Disposition, gentle, docile	2							
B. Head and neck — 8 points								
Muzzle, broad; nostrils large	1							
Eyes of good size, mild, bright	1							
Face, lean, fine, shapely	1							
Forehead, broad	2							
Ears, not coarse; size, medium; inside yellow	1							
Neck, fine, rather long, well set on shoulders and head; top line slightly curved; throat clean; dewlap light	2							
C. Fore quarters — 5 points								
Withers, lean, thin, not rough	1							
Shoulders, light, oblique	2							
Legs, straight, short; shank, fine; feet, well placed	2							
D. Body — 17 points								
Chest, deep, low, full; girth, large, . . . inches	4							
Crops, not deeply depressed	1							
Ribs, long, broad, well sprung, wide apart .	3							
Back, lean, strong, "spinal processes" well defined	2							
Stomach, deep; girth, large, . . . inches . .	3							
Loin, broad, long, level, last rib to hip . . inches	3							
Flanks, low, deep from hip down	1							
E. Hind quarters — 14 points								
Hips, wide apart	3							
Rump, broad, level; long, . . . inches . . .	3							
Pin bones (or thurls), high, wide apart . .	1							
Thighs, thin, roomy, long, well carried . . .	3							
Legs, straight, short, wide apart; shank, fine	3							
Tail, long, fine, reaching hocks, switch good .	1							
F. Udder — 34 points								
Front udder, carried well forward, full, thick, soft, mellow within; quarters, even . . .	12							
Hind udder, full in form, well up behind, good width, mellow, even	10							
Milk veins, large, long, elastic, tortuous . .	6							
Milk wells, large	2							
Teats, 2½ to 3 inches long, good size, well placed	4							
Total	100							

2. Compare two dairy cows from the standpoints of constitution, capacity, temperament, circulation, and ability.

3. Judge according to score card the best types of dairy breeds obtainable in your neighborhood. This exercise will require several hour periods.

4. Write in a brief story the characteristics of the Jersey and Holstein cattle. This may be an exercise in language work.

5. With Babcock Tester test several samples of whole milk. (*An eight bottle closed tester is best for school use. Open testers are inaccurate and dangerous.*)

Directions. — First get a good sample of milk by pouring milk back and forth from one vessel into another several times.

Fill milk pipette up to mark, 17.6 c.c. of milk. Pour the milk into the whole milk test bottle. Then add 17.5 c.c. of sulphuric acid (sp. gr. 1.82); with a whirling motion mix milk and acid thoroughly. Whirl in tester for five minutes. Then fill bottles about up to the base of the neck with warm water. (Temperature about 150° Fahr.) Whirl for three minutes. Then fill bottles well up on the graduations with warm water. Whirl for one minute. Read butterfat test.

6. Test some skim milk and buttermilk in the same manner.

7. Figure the value of the milk produced by Cylene Jewel (page 114) at 20 cents per gallon. Also the value of the butterfat at 30 cents per pound.

8. Get from your parents or from a neighbor the ration fed to a dairy cow, and figure its cost. Have pupils put these on the board.

9. Keep the number of pounds of milk produced and test of a milch cow for two months. Weigh and test milk produced the first and fifteenth day of each two months. Keep your record.

10. Debate; *Resolved*, That the dairy cow is more important to the people of the United States than all other farm animals combined.

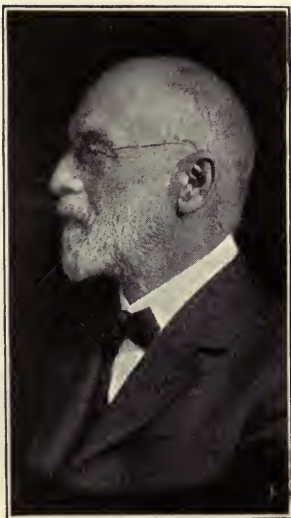


FIG. 47. — Dr. S. M. Babcock, the inventor of the Babcock test, which aids the dairyman to determine whether a cow is producing butterfat economically.

CHAPTER VII

SWINE PRODUCTION

Wild swine. — It is reported upon good authority that there were about twenty species of wild hogs. The wild boar is prob-



Courtesy of Orange Judd Co.

FIG. 48. — Wild boar — ancestor of all modern breeds of swine.

ably the immediate ancestor of our domestic swine. He was tall, slender, deficient in sides and rear quarters, and had heavy shoulders. The wild boar had at least three means of protection: he was a fleet runner; his long tusks were good fighting implements; and his skin and hair were heavy.

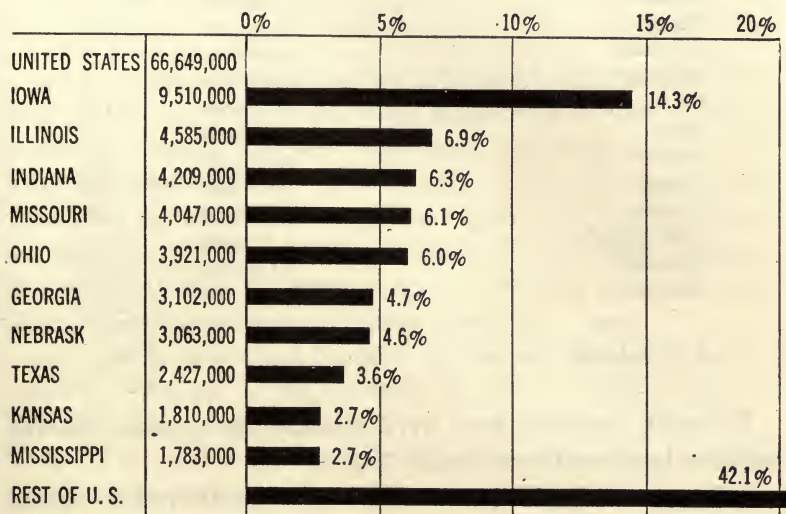
Wild hogs liked moist, damp, warm places best. They sought places near streams where the underbrush was dense, where herbs, roots, insects, and refreshing waters abounded. "Root, hog, or die," was a natural act of the wild hog. By rooting, they secured the foods they needed, — roots, herbs, insects, and worms. Domestic hogs likewise root up the pasture to secure the food they crave and need. Corn-fed hogs will root up the entire pasture in the spring to get

Note to the Teacher: The materials needed to do the Laboratory Exercises and Home Projects at the close of this chapter are:

Hogs of different breeds to score.

worms and roots. These furnish an additional amount of protein substance, which aids in building up bone, muscle, and tissue. Swine that are fed a well-balanced ration will usually not root up large areas.

Swine-producing states. — While hogs are produced in every state of the United States, the states of the corn belt are the ones that furnish the surplus of swine products. The ten leading swine states, in numbers and percentage of swine produced for one year, are as follows :¹



GRAPH 3. — The leading states in swine production.

About 57 per cent of all the hogs produced in the United States are raised in the above ten states. The average number of hogs per farm in Iowa is 35, and in other states it ranges from that down to less than one per farm.²

¹ Data for 1921 taken from U. S. Yearbook of Agriculture.

² 1910 census.

The United States produces about 40 per cent of the hogs in the world, therefore the price of hogs prevailing in the United States almost sets the world price level on hogs. The number of hogs, according to a recent report, in the different nations is as follows :

WORLD SWINE DISTRIBUTION

		PER CENT
World	177,853,000	
United States	66,649,000	37.5
Russia	19,565,000	11.0
Brazil	17,329,000	9.7
Germany	14,269,000	8.0
Hungary	6,825,000	3.8
Austria	6,432,000	3.6
Spain	4,997,000	2.8
France	4,081,000	2.3
Canada	3,517,000	2.0
England	3,113,000	1.8
Phil. Islands	2,735,000	1.5
Denmark	1,000,000	0.6
Sweden	717,000	0.4
Total		85.
Rest of World		15.

Denmark produces hogs very scientifically and secures the gains on hogs mostly on forage crops.

Advantages in pork production. — 1. The first advantage of pork production is the rapidity with which swine multiply. Sheep, cattle, and horses usually average less than one offspring per year. From ten to fourteen pigs are frequently produced in a year from one pair of hogs.

2. Hogs require less feed to produce a hundred pounds of meat than do other farm animals. From 500 to 600 pounds of corn, or its equivalent, will produce 100 pounds of pork, while in the case of a steer it requires from 1000 to 1100 pounds of corn

to produce 100 pounds of beef, and from 800 to 900 pounds of feed to produce 100 pounds of mutton. However, sheep and cattle consume feeds of a different nature, and for that reason may make more economic gains.

3. Hogs dress out a higher percentage of carcass, as shown by the following comparison :

ANIMAL	PER CENT DRESSED CARCASS
Swine	70-77
Steers	60-66
Sheep	50-55

4. A fourth advantage in pork production arises from the fact that swine consume large quantities of feeds that otherwise would be wasted. In the cattle feed lots, hogs eat the corn that the steers leave. From 150 to 300 pounds of hogs may profitably follow a thousand-pound steer that is on a full-fed corn ration. On the dairy farm, skim milk, buttermilk, and whey are excellent feed for swine. Insects and the grass and roots along streams and fences are eaten by swine.

5. A fifth advantage in pork production is that instead of hauling from 500 to 600 pounds of corn to market only 100 pounds of pork need be hauled.

6. The fertility of the soil may, by proper farm management, be maintained where hogs are raised.

Economic pork production. — Young pigs put on more weight with less feed than do old large hogs. This is shown in the following table, which gives average results at American Experiment Stations, where more than 2200 hogs were fed in over 500 feeding trials. In order to balance the ration in these trials, skim milk and whey were provided as a part of the feed. Six pounds of skim milk and twelve pounds of whey were counted equivalent to one pound of concentrates.

RELATION OF WEIGHT OF PIGS TO FEED USED AND THE AMOUNT OF GAINS
MADE BY PIGS OF DIFFERENT WEIGHTS

WEIGHT OF PIGS	ACTUAL AVERAGE WEIGHT	NUMBER OF ANIMALS FED	AVERAGE FEED EATEN PER DAY	FEED EATEN DAILY PER 100 POUNDS LIVE WEIGHT	AVERAGE GAIN PER DAY	FEED PER 100 POUNDS GAIN
Pounds	Pounds		Pounds	Pounds	Pounds	Pounds
15-50 . . .	38	174	2.2	6.0	0.8	293
50-100 . . .	78	417	3.4	4.3	0.8	400
100-150 . . .	128	495	4.8	3.8	1.1	437
150-200 . . .	174	489	5.9	3.5	1.2	482
200-250 . . .	226	300	6.6	2.9	1.3	498
250-300 . . .	271	223	7.4	2.7	1.5	511
300-350 . . .	320	105	7.5	2.4	1.4	535

From the above table, 174 pigs that weighed on an average of 38 pounds put on 100 pounds of gain with 293 pounds of feed; and 105 hogs, weighing on an average of 320 pounds, put on 100 pounds of gain with 535 pounds of feed. Why such a large difference? Because it requires more feed to maintain a 320-pound hog than it does to maintain a 38-pound pig. Since young hogs make greater gains with less feed than do older hogs, the practice has become quite general in recent times to market hogs when they are from six to eight months old and weigh from 175 to 225 pounds.

However, this is a matter that again calls for the exercise of judgment on the part of the farmer, for local or temporary conditions must be taken into consideration, as they affect both the prices of hogs and of feeds.

A second factor in reducing the cost of pork production is an "All Year Hog Pasture." Such a plan was most excellently suggested by Mr. Sam Jordan when County Farm Adviser of Pettis County, Missouri.

ALL YEAR HOG PASTURE

LOT I — THREE ACRES

Sow to rye early in the fall.

Pasture from about Dec. 15th to the last of May. Plow under and sow to soybeans. Pasture soybeans as soon as they begin to ripen, until all are eaten.

LOT III — TWO ACRES

Sow to rape about May 1st.

Pasture from last of June to middle of August, when hogs are put back on Lot II. Pasture again when hogs are done with soybeans on Lot I, until rye is ready on Lot II.

Water
Tank

LOT II — THREE ACRES

Sow oats and rape in early spring, to be pastured when hogs are removed from the rye on Lot I until last of June.

Pasture again from middle of Aug. until soybeans are ready. Remove hogs to soybean field, Lot I, and plow and sow rye. This rye may be pastured from Dec. 15 to following spring.

LOT IV — TWO ACRES

Permanent pastures of blue grass and white clover or alfalfa.

This is to be used as a reserve for such times as other lots might not be ready or could not be used.

“This ten acres,” Mr. Jordan says, “should carry from 50 to 75 grown hogs, depending on the quality of the soil, the season, and the supplementary feed. If this plan is followed and about a half-grain ration fed, pork can be produced for about one half of what it can be produced when nothing but grain is fed. If we can sell hogs for 8 cents per pound and it costs 8 cents a pound to produce them, we had better stay out of the hog business.”¹

The advantages of the “All Year Hog Pasture” are:

¹ Sam Jordan; “All Year Hog Pasture.”

1. It reduces the cost of pork production about half.
2. It improves the fertility of the soil.
3. It provides a well-balanced ration and keeps the hogs in the best of health condition.
4. Because the soil has been cultivated and the hogs are shifted from pasture to pasture, the soil does not easily become contaminated.

A third factor in economic pork production is properly balancing the ration. The picture (Fig. 49) shows that corn alone



Courtesy of Orange Judd Co.

FIG. 49. — Protein is very important. The larger two were fed skim milk and wheat middlings with corn; the smaller two were given corn only.

does not support the tissues of swine, because it does not provide enough protein. When skim milk and wheat middlings were added, the necessary amount of protein was fed, the ration was balanced, and as a result the pigs did better.

In the corn belt, it is generally believed that pork cannot be produced without corn. This opinion is not supported by the conditions under which the wild hogs lived in the forests of Europe, Asia, and Africa, when they ate herbs, roots, worms, snakes, insects, and grew fairly well. However, when a well-balanced ration is provided, pork is produced more cheaply.

If corn or wheat products are fed, some linseed oil meal, tankage, skim milk, ground alfalfa hay, soybeans, or cowpeas will help to balance the ration. A few simple rations follow:

- | | |
|------------------------|----------|
| 1. Corn | 3 parts |
| 2. Skim milk | 5 parts |
| 1. Corn | 14 parts |
| 2. Tankage | 1 part |
| 3. Shorts | 2 parts |

- | | |
|----------------------|---------|
| 1. Corn | 6 parts |
| 2. Alfalfa | 1 part |

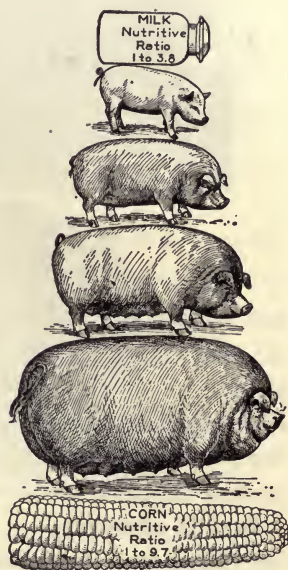
1. Corn
2. Pasture grasses
3. Skim milk

A fourth factor in economic pork production is improving the herd. The razorback is a thing of the past, because he does not dress out a high per cent of pork; nor does he fatten economically. The picture (Fig. 51) illustrates the difference between a razorback and a half-pure breed.

The razorback is a scrub, and will sell slowly for scrub prices; the half breed sells more readily, and for better prices.

Types of swine. — There are two types of swine; namely, the lard and the bacon types. The bacon type is comparatively narrow over the back, the quarters are somewhat smaller, but the sides are deep and long. From the bacon type we have breakfast bacon, which, in many places, is the highest priced cut. The finest bacon is intermingled with a great deal of lean. This is the kind of meat generally exported, because it satisfies foreign trade. The people of England are especially fond of breakfast bacon.

Hogs of the lard type have broad backs, full quarters, and



Courtesy of Orange Judd Co.

FIG. 50. — From milk to corn. As the animal grows, the ration widens. The cut shows a valuable lesson regarding feeding the swine. The same lesson holds true for the feeding of other live stock.

short legs. They have the greatest capacity to put on fat, and represent, therefore, the best conformation for maximum pork production. The disposition of the lard types is slow, sluggish,



Courtesy of Orange Judd Co.

FIG. 51. — How breeding improves the stock, — a half-pure breed and a razorback.

and lymphatic. They put on fat readily and often become too fat, especially for show purposes. Judges at State Fairs, and elsewhere, should discount hogs that carry a surplus of fat. Hogs should be judged in accordance with their purpose. Breeding stock should be in good living condition, and hogs for the market should be reasonably fat.

Breeds of swine. — 1. *Berkshire* hogs came from Berkshire County, England, and are now widely distributed. In England, the Berkshires are not quite so broad-backed, but in the corn belt they soon become typical lard hogs. Berkshires have short, dished



FIG. 52. — The Berkshire. Lard type.

faces, their ears are short and stand erect, and their bodies are long and deep, but not quite so wide as those of some other breeds. Their backs are slightly arched. The color of the

Berkshires is black, with five or six white points. Generally the head, feet, and tail are partially white.

The Berkshires are excellent feeders and fatteners, are of fine quality, prolific, and are very adaptable to a wide range of climatic conditions.

2. *Poland China* hogs originated in the Miami Valley of Ohio from 1816 to 1840. They are very compact, close to the ground, and typical of the lard type. They are black, with white feet, tail, and face. White elsewhere on the body does not show impurity of blood. The face is straight, and the ears break at the upper third.

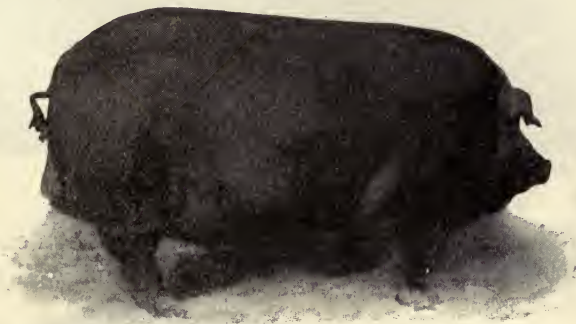


FIG. 53. — The Poland China. Lard type.

The chief adverse criticism on the breed is their lack of prolificacy. However, it has been found that the average of one thousand eighty-six Poland China litters was 7.45 pigs each.¹

The strong points of the Poland China breed are their early maturing, and their feeding and fattening qualities. They are widely distributed and a very popular breed in America.

3. *Duroc Jersey* hogs originated in the State of New York. In 1872, the National Swine Breeders' Convention practically

¹ Plumb; "Types and Breeds of Farm Animals."

set the essential characteristics that this breed was to possess. Hogs of this breed are a solid red, ranging from a dark cherry

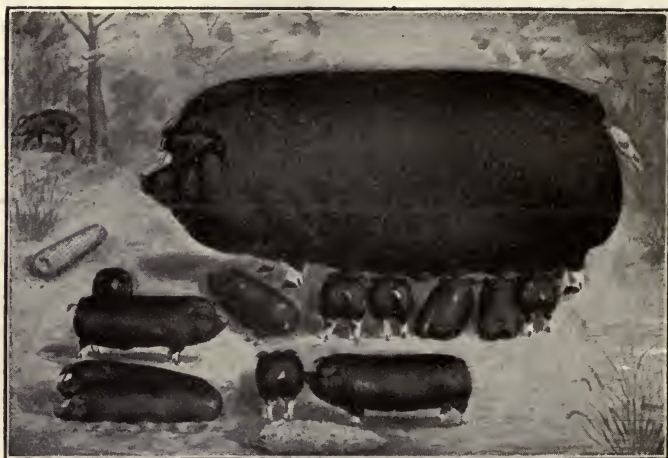


FIG. 54. — Poland China pigs.

red to a lighter red. They are in body conformation essentially the same as the Poland China breed. They rank well with the other lard hogs in per cent of dressed carcass. A well-finished 100-pound pig will dress out 72 pounds or seventy-two per cent, and a 300-pound hog well finished will dress out about 237 pounds or seventy-nine per cent.



FIG. 55. — The Duroc Jersey. Lard type.

CLASSIFICATION OF SWINE

1. Lard Types:
 1. Berkshire
 2. Poland China
 3. Duroc Jersey
 4. Chester White
2. Bacon Types:
 1. Yorkshire
 2. Tamworth
 3. Hampshire

Feeding a balanced ration. — Feeding hogs a balanced ration aids much in economic pork production. Growing pigs should

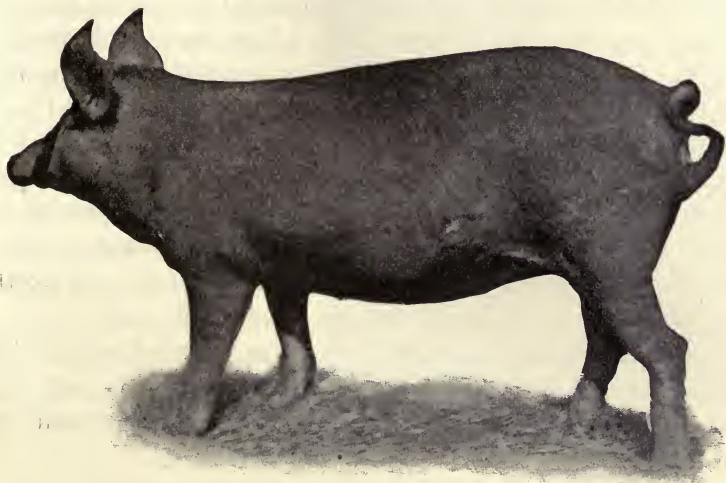


FIG. 56. — The Tamworth. Bacon type.

be given feed which develops the frame and spring of ribs. Feeds rich in protein such as skim milk, buttermilk, clover, and alfalfa are fine feeds for producing growth in pigs. Bran is also a fair feed for growing pigs. A small amount of bone meal, — one ounce, equal to about 4 tablespoonfuls, daily to every 10 or 12 pigs having a total weight of 200 to 300 pounds is unexcelled as a frame-producing feed. It may be fed in the slop or in a dry mash placed in a self-feeder. Forage crops composed of blue grass, white clover, rape, vetch, and alfalfa are unexcelled in giving hogs exercise and spring of ribs.

In fattening pigs a balanced ration produces the greatest gains at the lowest cost. Hogs that are matured will fatten fairly well in a short fattening period on corn alone. Old hogs in short fattening periods will do better if fed a balanced ration than if fed corn alone. In an experiment by the author 4 pigs made greater gains at a lower cost on a fairly well balanced ration composed of corn, shorts and tankage than did 5 hogs fed corn and shorts, — an unbalanced ration. The 5 hogs increased in weight from 730 to 1300 pounds in 80 days, the average daily gain was 1.26 pounds at a cost of 4.7 cents per pound, and it required 5.94 pounds of feed to make one pound of gain. The four hogs fed corn, shorts and tankage increased in weight from 560 to 1296 pounds in 90 days, the average daily gain was 2.04 pounds at cost of 4.3 cents per pound, and it required 4.94 pounds of feed to make one pound of gain. In this experiment corn was worth \$1.35 per hundred; shorts \$1.60; and tankage \$3.25.

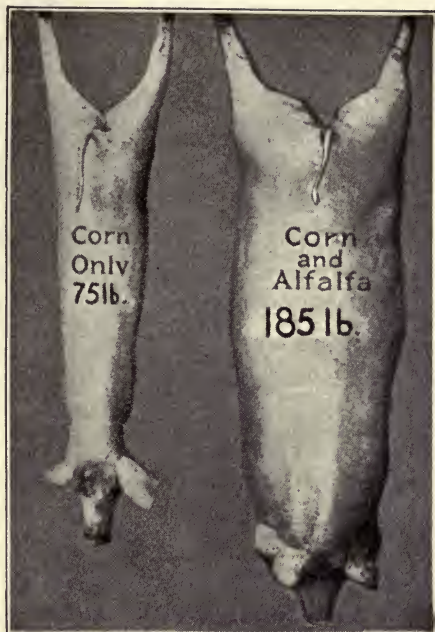
At the Kansas Station, a group of 7 pigs were fed in a dry lot on corn alone. Another lot of similar pigs were fed corn and alfalfa. Both lots were fed 182 days. Here are the results of that experiment:

CORN *vs.* CORN AND ALFALFA FOR HOGS

	FEED	GAIN IN 182 DAYS	AVERAGE DAILY GAIN	AVERAGE BREAKING STRENGTH OF THIGH BONES
		Pounds	Pounds	Pounds
Lot I	Corn alone and water	75	0.31	570
Lot II	Corn, alfalfa, and water	185	1.00	1370

It will be noticed that the pigs fed corn alone made a daily gain of 0.31 pound; and those fed corn and alfalfa made a daily

gain of 1 pound, or they did three times as well as did the pigs fed corn alone. Besides this the pigs in lot II had a much larger and stronger skeleton as the last column in the above table shows. The pigs of lot I made 100 pounds gain at a cost of \$31.49, while those of lot II made 100 pounds gain at a cost of \$6.68. When a balanced ration is fed, less feed is needed to produce 100 pounds gain. In an experiment with 180 pigs in each group the following results were secured with feeding corn alone, and corn and a nitrogenous supplement. The supplementary feeds were composed of tankage, shorts, cowpeas, and soybean hay.



Courtesy Kansas Experiment Station.

FIG. 57. — Corn and alfalfa were a fairly good ration. Alfalfa balances the rations if fed with corn.

CORN vs. CORN AND NITROGENOUS SUPPLEMENT

	FEED	INITIAL WEIGHT	DAILY GAIN	FEED FOR 100 POUNDS GAIN
		Pounds	Pounds	Pounds
Lot I 180 pigs	Corn alone 4.8 lb.	115	0.9	602
Lot II 180 pigs	Corn and ni- trogenous supplement 4.3 lb.	117	1.3	441

The pigs of lot II, fed corn and a nitrogenous supplement, made 40 per cent greater gains and required 27 per cent less feed to make 100 pounds of gain.

Prevention of hog diseases. — Hogs that are healthy have a strong resistance to disease. They may be kept healthy by providing clean quarters and clean water, and by feeding a balanced ration. If every cell and tissue of the body is well fed, the hog keeps strong and vigorous, and disease finds no fertile field or weakened organs in which to develop. On the other hand, if hogs are not fed a well-balanced ration, some parts of the cells are not properly nourished. These cells become weakened, and disease germs soon overtake the weakened parts. Strong, healthy hogs are seldom sick.

Hogs should be kept free from worms and lice, because they reduce the vitality of the hogs. When herds are infested with worms, it is well to use six grams of santonin and four grains of calomel per one hundred pounds of live weight. This may be fed in slop after hogs have had no feed for about twenty-four to thirty-six hours. Lice may be destroyed and kept away by dipping hogs every six or eight weeks in the summer season. A concrete vat filled with crude oil furnishes one of the cheapest and best dips. Spraying hogs with a good disinfectant will also do away with lice.

Hogs will not need treatment often if they are provided clean, sanitary quarters. The saying, "dirty as a hog," has no application in the hog kingdom. The hog does not like filthy and unclean quarters, and if man will do his part in maintaining clean quarters, the hog will be healthy, free from lice and worms. Under healthful conditions the maximum growth and thrift in hogs may be secured.

Hog cholera. — Hog cholera causes an annual loss of about \$65,000,000 in the United States. This disease is caused, like

many other diseases, by a small germ which remains unidentified up to the present time. These germs may be carried by man, mice, dogs, crows, pigeons, sparrows, and on wagons. Hogs that get sick should be isolated and put into a pen that is covered with netting, so neither mice nor sparrows can get in. All hogs that die of cholera should be burned, and the hog quarters thoroughly disinfected. A good disinfectant is fresh air-slaked lime. It should be used freely on the floors of hog houses and over the ground of pens and feed lots. After two or three days the lime may be scraped together and hauled out into the fields. Other disinfectants may be occasionally used to advantage.

“An ounce of prevention is worth a pound of cure,” applies more forcibly to hog cholera than to almost any other disease. However, when all measures of prevention have failed, then remedies must be used. Calling in a veterinarian, or the Farm Adviser, when the disease first appears is most economical. Vaccination, if needed, should be administered early.

In all contagious diseases, whether of animals or of man, it is common courtesy to one's neighbors to put up a sign. Whenever hog cholera exists, the sign to be posted is, “Hog Cholera Here.” Putting up such a sign is a neighborly act.

Summary. — Raising and selling hogs is so profitable that they are frequently called *mortgage lifters*. Early maturity of swine lessens the cost of producing pork. A well-balanced ration also reduces the cost of production; the use of forage crops is almost indispensable in successful swine husbandry. Providing clean quarters, keeping the hogs healthy and vigorous, and feeding carefully, are large factors in preventing disease. The economic production of swine deserves our careful study and attention.

LABORATORY EXERCISES AND HOME PROJECTS

1. Have the pupils take a survey of the district, finding the breeds and numbers of hogs and their value. Fill out an outline similar to the following one and keep in your permanent notebook.

HOG SURVEY OF THE DISTRICT

FARMER'S NAME	HOGS	VALUE	PIGS	BREED	TOTAL VALUE

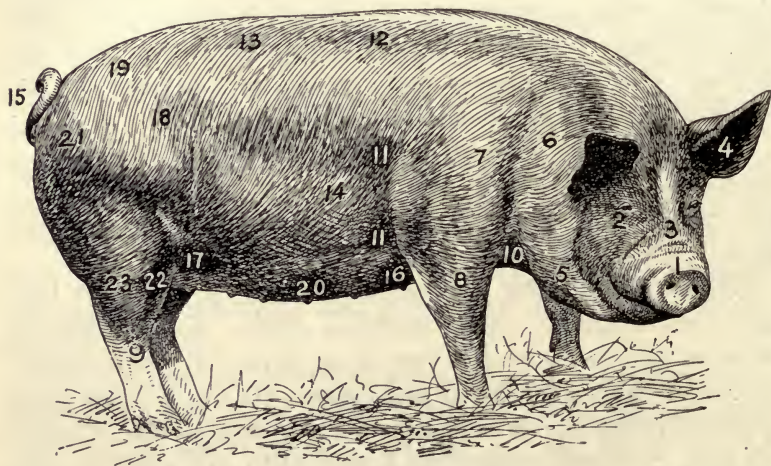


FIG. 58. — Points of the pig.

- | | | |
|--------------|------------------|-------------|
| 1. Snout. | 10. Breast. | 19. Rump. |
| 2. Eye. | 11. Breast line. | 20. Belly. |
| 3. Face. | 12. Back. | 21. Ham. |
| 4. Ear. | 13. Loin. | 22. Stifle. |
| 5. Jowl. | 14. Side. | 23. Hock. |
| 6. Neck. | 15. Tail. | |
| 7. Shoulder. | 16. Fore flank. | |
| 8. Fore leg. | 17. Hind flank. | |
| 9. Hind leg. | 18. Hip. | |

2. If five and one half pounds of corn will produce one pound of pork, how many pounds of pork may be produced from 40 acres of corn yielding 27.5 bushels per acre?

3. If the hogs in the above problem sell for $7\frac{1}{2}$ cents per pound, and corn is worth 1 cent per pound, or 56 cents per bushel, how much will the farmer make from tilling such 40 acres of corn?

4. If it costs 4 cents per bushel to have corn gathered or husked, how much can a farmer save by "hogging down" 40 acres of corn yielding the average produced in the United States, namely, 27.5 bushels per acre?

5. Have pupils make miniature hog houses out of pasteboard, and have them discuss the essentials of a good hog house.

6. Score hogs according to the following score card.

LARD HOGS — SCORE CARD

SCALE OF POINTS	BREED							
1. General appearance — 34 points								
Weight according to age	4							
Form, arched back, straight underline, smooth, compact, medium length, standing squarely on legs	10							
Quality, hair smooth and fine, bone medium size, clean, strong, and refined	10							
Condition, indicating health and high capacity for dressed carcass	10							
2. Head and neck — 8 points								
Snout, medium length, not coarse	1							
Face, short, broad	1							
Eyes, clear, not sunken, free from wrinkles	1							
Ears, carried according to breed, fine, medium size	1							
Jowl, full, firm, free from wrinkles	2							

LARD HOGS — SCORE CARD (*Continued*)

SCALE OF POINTS	BREED							
Neck, thick, short, smooth to shoulder	2							
3. Fore quarters — 12 points								
Shoulders, broad, deep, smooth, compact at top	8							
Breast, wide, deep, breast bone advanced	2							
Legs, straight, short, strong, pasterns strong	2							
4. Body — 32 points								
Chest, deep, wide, large girth, fore flank full	4							
Sides, deep, broad, full, thickly and evenly fleshed	6							
Back, broad, strongly arched, well fleshed	10							
Loin, wide, strong, and well fleshed	10							
Flank, straight, full, and low	2							
5. Hind quarters — 14 points								
Hips, wide apart, smooth	2							
Rump, long, level, wide, evenly fleshed	2							
Ham, deep, wide, full, well fleshed	8							
Pasterns, strong, straight, upright	2							
Total	100							

7. Pupils may be given an "Essay-writing Contest" on one of several topics in connection with the study of swine. Such topics as these may be used: "Origin and Improvement of the Hog," "Feeding Hogs," "Money in Hogs," "Treatment of Diseases of Hogs," "How to Produce Cheaper Meat," "Time of Year to Raise Hogs in Order to Make the Most Money out of Them."

CHAPTER VIII

SHEEP PRODUCTION

It is generally believed that the Argali of Asia, and the Musimon of the islands of Crete and Cyprus are the real parents of our domestic sheep. The Argali is found on the plains and the mountain sides of Asia, and the Musimon is still found on the islands of Corsica and Sardinia in the Mediterranean Sea. Both of these wild types have been crossed with our domestic breeds and the progeny easily becomes domesticated.

The habits and instincts of the wild sheep are still found in our domestic breeds

(1) Wild sheep sought the highest places, partly because they were dry and partly to escape their enemies. Domestic sheep



FIG. 59. — The Musimon, one of the wild ancestors of our domestic sheep. Had little wool, and some mutton.

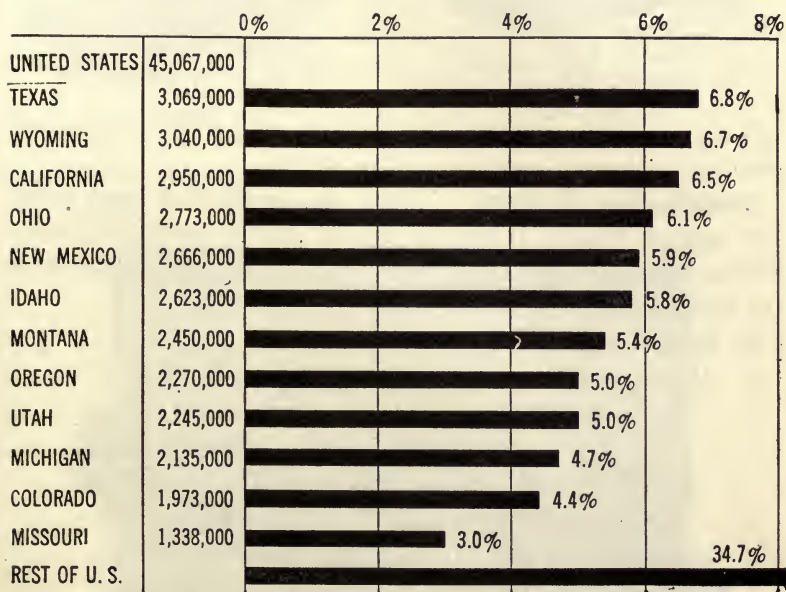
Note to the Teacher: The materials needed to do the Laboratory Exercises and Home Projects suggested at the close of this chapter are:

At least two sheep to judge.

will also seek the highest places to fold for the night. (2) Sheep do not like to go into stables or cross streams, but they will follow a leader. Shepherds make use of this instinct to drive sheep across a stream and into a stable. After one has gone, the rest will follow. (3) When sheep are excited, they stamp the earth with a front foot, a signal to the herd of approaching danger. (4) Sheep, and especially lambs, have a great play instinct. They jump stumps, low straw stacks, or play around open ditches. If a barrel is set up, and two boards leaned against the barrel, lambs will run up one board and down the other, seemingly in great amusement. (5) Sheep eat weeds in a very strange way. One weed is not eaten down by one sheep, but each sheep of the herd takes a nibble as it passes until the weed is eaten. Sheep can graze the turf closely because their upper lip is split, and because they have sharp incisors. Sheep are called *plant scavengers*, because they eat about nine tenths of all the weeds and shrubs found in pastures; horses and cattle will touch less than half of them. Sheep also graze steep hill-sides where cattle and horses cannot go. Weed-infested pastures in which sheep are grazed actually not only carry the sheep but also an added number of cattle, after the weeds have been destroyed and the grass has been given a chance to grow. Cut-over timber lands unless the growth is too rank can be almost as effectually cleaned up by sheep as by goats. It is very much more economical to have weeds destroyed by sheep than by paid labor. Another important feature of sheep-raising can only be touched upon here. The income from wool and that from the lambs and mutton is derived at different periods of the year. As a rule prices of mutton and lamb accord with wool prices, but it seldom happens that all these products sell at bottom prices at the same time. It is always possible in such a case to store the wool clip for a better market.

Importance of sheep. — According to the 1920 Census Report, there were 45,067,000 sheep in the United States, worth on an average, about \$10.80 per head. The income from these sheep is about one third as much as the income from poultry.

Sheep states. — Although sheep are found to some extent in every state of the United States, they are mainly raised in the rolling sections of the West. The following twelve states are the leaders, producing about 65 per cent of the entire sheep crop. Texas, Wyoming, and California produce almost 20 per cent of all the sheep produced in the United States.



GRAPH 4. — The leading states in sheep production.

Sheep in the world. — The United States has about 10 per cent of the sheep of the world. The world price levels on sheep and wool, therefore, are set by other nations. The leading sheep-

producing nations for 1920, according to statistics of that year, were:

Australia	78,000,000
Argentina	45,300,000
United States	45,067,000
European Russia	40,749,000
Asiatic Russia	37,000,000
New Zealand	24,000,000
Great Britain	23,407,000
British India	19,235,000
Spain	18,600,000
Germany	14,269,000
Uruguay	11,473,000
Turkey	11,200,000
France	8,999,000
Canada	3,721,000

Some of these countries, like Australia and New Zealand, are producers of a very superior quality of wool.

Classification of sheep. — Sheep are classified as wool sheep and mutton sheep. However, typical mutton-producing sheep will produce some wool, and vice versa. Sheep are divided into the following classes:

Fine Wool Breeds:

1. American Merino 2. Delaine 3. Rambouillet



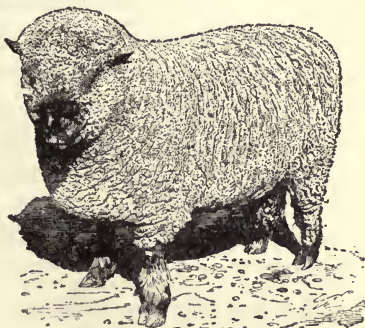
FIG. 60. — A pair of American Merinos. Examples of the fine wool type.

Medium Wool Breeds :

- | | | |
|--------------------|-----------------|----------------|
| 1. Southdown | 4. Oxford Down | 6. Dorset Horn |
| 2. Hampshire Down | 5. Suffolk Down | 7. Cheviot |
| 3. Shropshire Down | | |



Shropshire ewe.



Shropshire ram.

FIG. 61. — Examples of medium wool type.

Long Wool Breeds :

- | | | |
|------------|--------------|-------------|
| 1. Lincoln | 2. Leicester | 3. Cotswold |
|------------|--------------|-------------|



FIG. 62. — Lincoln ram. An example of a long wool type.

SOME FACTS ABOUT SHEEP¹

	NATIVE HOME	COLOR OF POINTS	LENGTH OF WOOL	DIAMETER OF WOOL	WEIGHT OF FLEECE	WEIGHT OF SHEEP	PER CENT DRESSED CARCASS
			Inches	Inches	Pounds	Pounds	
American Merinos .	America	White	2-2 $\frac{1}{4}$	$\frac{1}{1194}$	12-25	100-150	50.7
Delaine . .	United States	White	3-5	$\frac{1}{1194}$	10-20	100-150	50.7
Rambouillet	France	White	3-4	$\frac{1}{1194}$	10-15	150-185	50.7
Southdown .	England	Gray	2-3	$\frac{1}{865}$	4-8	123-175	55.3
Cotswold .	England	White	8-14	$\frac{1}{605}$	10-14	200-265	54.2

The fleece of the Merinos is short and very fine, but is very dense on the body. By *density* is meant the number of fibers that grow on a square inch. The wool of the long wool types is not so dense, is thicker in diameter, and much longer. The wool from the fine wool breeds is made into the finest woollen fabrics; the wool from the medium wool breeds is made into heavier woollen clothes; and the wool from the long wool breeds is made into carpets, rugs, and other coarse woollen articles.

Sheep, in the North Central States, are raised mainly for their meat. The fleece, weighing about 8 pounds, being worth about 25 to 30 cents per pound (or about \$2), pays for the keep of the sheep. The lamb sold for meat weighs usually from 75 to 100 pounds, bringing about 7 or 8 cents per pound (worth \$7.50). The latter is the main purpose of sheep production in many parts of the United States.

Shelter for sheep. — In dry regions sheep need little more than open sheds for protection, but in damp, cold regions they need closed sheds and barns, for when the fleece becomes thoroughly soaked, 5 or 6 days are necessary to dry it out. Under

¹ Harper; "Animal Husbandry for Schools."

such conditions the sheep take pneumonia, colds, and other diseases, and need additional feed and care. The wool from fleece that has been soaked is never so good. Keeping sheep dry, therefore, increases the profits of the sheep-raiser.

Lambs more economical fatteners. — Professor Shaw, at the Montana Station, in order to determine the relation of age to economical fattening, conducted an experiment with sheep of four ages, and about fifty sheep in each group. The following table gives the results of the experiment :

RELATION OF AGE TO FEED FED AND GAINS MADE¹

	AVERAGE RATION Pounds		AVERAGE WEIGHT AT BE- GINNING	AVERAGE DAILY GAIN	AVERAGE TOTAL GAIN	FEED PER 100 POUNDS Gain in Pounds	
	Barley	Clover Hay				Barley	Clover Hay
			Pounds	Pounds	Pounds		
Lambs . . .	0.7	2.1	63	0.27	23.7	253	763
Wethers							
One year old	0.7	3.8	95	0.27	23.5	256	1413
Wethers							
Two years old	0.7	4.1	116	0.28	24.3	248	1469
Aged ewes . .	0.7	2.3	92	0.18	15.6	387	1320

It will be observed that the amount of grain fed was practically the same per one hundred pounds gain in all cases, except in the case of aged ewes, but that only 763 pounds of clover hay was required for the lambs to make 100 pounds gain, as opposed to about 1400 pounds of hay for the other three lots, or a difference of about 700 pounds of hay saved in feeding lambs. This at a half cent per pound would be worth \$3.50, which is

¹ Montana Bulletin No. 35.

a very large saving in favor of the lambs per hundredweight gain.

Pure bred sires. — The use of pure bred sires, of proper conformation, quality, and disposition, often reduces the cost of mutton production. It is said that the sire is half of the herd. In the first generation he is half; in the second, three fourths; in the third, seven eighths, and so on, until the entire flock becomes a very high-grade group. The choice of a good pure bred sire is very important.

At the University of Missouri,¹ a group of Western ewes were mated to a pure bred mutton ram, and another group of similar Western ewes were mated to a scrub ram. There were 17 lambs in each lot.

The lot of good lambs averaged 60 pounds when 3 months old, and sold for \$7.35 per hundredweight; the scrub lambs averaged 56 pounds when 4 months old, and sold for \$4.50 per hundredweight.

Notice the width of neck, body, withers, hips, thickness of quarters, and size of the good lamb shown in Figure 63.

Lambing time. — Lambing time, according to the author's teacher, Professor Kleinheintz, of the University of Wisconsin, is the "harvest time" of the shepherd. Then the shepherd must remain with his flock day and night. Ewes should be given separate pens, and weakly lambs should be helped in getting their first meal. Lambs should be kept warm until their bodies become dry; sometimes they must be wrapped in a dry, stove-heated, woolen cloth. The true shepherd is quiet, gentle, kindly, and sympathetic. These qualities are essential to securing the best results with sheep.

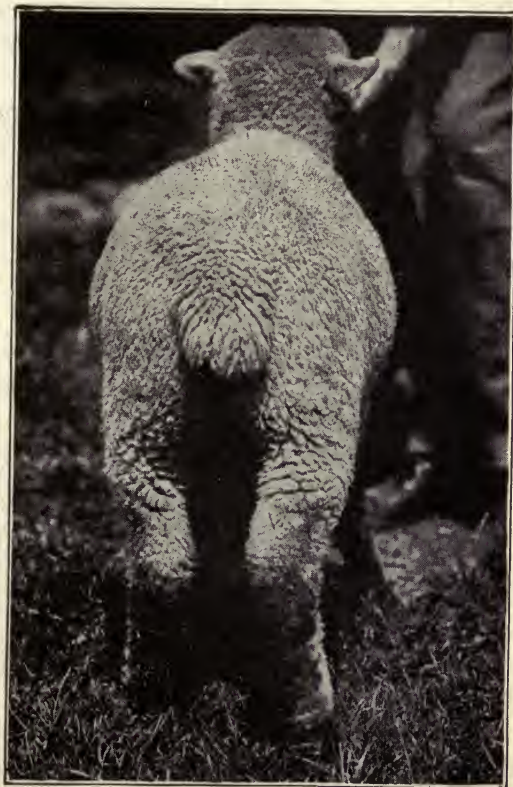
Docking lambs. — All lambs should be docked when about ten or twelve days old, in cold weather if possible. The tail is

¹ Cir. 65. "Advantages from the Use of Pure Bred Ram."

cut off with a sharp knife at the third or fourth joint from the body, where the skin on the under side of the tail begins to be covered with wool. The skin should be slipped as far as possible toward the body of the lamb before cutting. The wound should be disinfected with a 5 per cent solution of carbolic acid, and then covered with pine tar.

Dipping sheep.—

Sheep may be profitably dipped twice a year, once just after they are sheared and again in the autumn. The coal-tar preparations are probably the best and cheapest dips. The directions for their use are generally printed on the cans. Ordinarily



Courtesy of University of Missouri.

FIG. 63. — This good 60-pound lamb sold for \$7.35 per hundredweight when three months old.

one part of dip to one hundred parts of water is used. Dipping overcomes sheep scab and sheep ticks. According to Farmers' Bulletin No. 713, sheep scab is caused by a small parasitic mite. The female mite deposits 12 to 15 eggs which hatch in 3 or 4

days, mature in 7 or 8, and begin to lay eggs, the whole life cycle being complete in 12 days. When dipping sheep, care should be taken to have the dip warm, about 100° to 105° Fahr. After the sheep have all been dipped they should be kept in a warm, dry place not exposed to drafts.

Feeding sheep. — Corn, mixed with legume hay, is generally fed in the United States as far west as Colorado; farther west wheat or barley is used instead of corn. Lambs weighing from 60 to 80 pounds may be given the following daily ration:

Shelled corn	1.3 to 1.5 pounds
Clover or alfalfa	1.4 to 2.0 pounds

Corn stover, corn silage, corn, and oat straw may furnish the carbonaceous part of the feed. Clover hay, alfalfa, cowpeas, or soybean hay furnish the nitrogenous part of the feed. Sheep need feed for both flesh and wool. Wool is made up of a great deal of nitrogen, and therefore heavy wool producers should be fed a larger proportion of feeds rich in protein than are those that are to produce mutton only. Some interesting experiments have been made by the Wisconsin Experiment Station with regard to feeding of grain to lambs. These results have been well summarized by Professor Craig in "Sheep Farming in the United States," to which the student is referred.

Summary. — Sheep are largely produced in the Rocky Mountain regions. The production of mutton constitutes about two thirds of the sheep industry. However, the production of wool is important to the American people. Care and proper management help to make sheep more profitable. Unless sheep are given shelter, proper feed, and are protected from their enemies, the best results will not be secured. Docking, dipping, and starting the lambs properly are necessary for success in sheep production.

LABORATORY EXERCISES AND HOME PROJECTS

1. Write an essay on "The Grazing Methods of Sheep."
2. Write an argument of one hundred fifty to two hundred words, telling why raising of sheep should be encouraged in your county.
3. Make a survey of the number and kinds of sheep in your school district.
4. Score sheep according to the score card, see page 156.

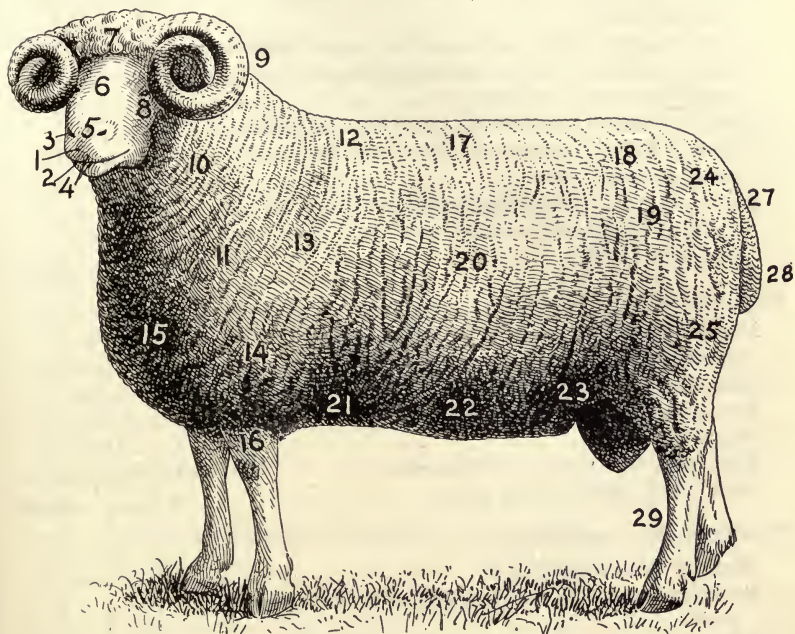


FIG. 64. — Points of a sheep.

- | | | |
|--------------|--------------------|--------------------|
| 1. Muzzle. | 11. Shoulder vein. | 21. Fore flank. |
| 2. Mouth. | 12. Shoulder top. | 22. Belly. |
| 3. Nostril. | 13. Shoulder. | 23. Hind flank. |
| 4. Lips. | 14. Arm. | 24. Rump. |
| 5. Nose. | 15. Brisket. | 25. Leg of mutton. |
| 6. Face. | 16. Fore leg. | 26. Dock. |
| 7. Forehead. | 17. Back. | 27. Twist. |
| 8. Eye. | 18. Loin. | 28. Hind leg. |
| 9. Ear. | 19. Hip. | |
| 10. Neck. | 20. Ribs. | |

SCORE CARD — MUTTON SHEEP

SCALE OF POINTS	NAME OF BREED			
Age, estimated — years, actual — years				
General appearance — 26 points				
Weight, estimated — lb., actual — lb., score according to age	6			
Form, straight topline and underline, deep, broad, low, medium length, symmetrical, compact, standing squarely on legs	8			
Quality, bone of firm texture, fine skin, silky hair, clearly defined features and joints, mellow touch, fleece soft, fine, pure	6			
Condition, thick, even, covering of firm flesh, especially in regions of valuable cuts, indicating finish, light in offal	6			
Head and neck — 8 points				
Muzzle, good size, lips thin, nostrils large and well apart, jaws wide	1			
Face, short, broad, profile straight	1			
Eyes, large, full, clear, bright	1			
Forehead, broad	1			
Ears, well carried, fine, medium size	1			
Neck, thick, short, throat clean	3			
Fore quarters — 10 points				
Shoulder vein, smooth, full	2			
Shoulders, smoothly covered with firm flesh, compact	4			
Brisket, broad, full, breast wide	2			
Legs, straight, short, wide apart; forearm full, shank fine; feet sound	2			
Body — 25 points				
Chest, deep, broad, girth large, fore flank full . .	4			
Back, broad, straight, medium length, thickly, evenly, and firmly fleshed	7			

SCORE CARD — MUTTON SHEEP (*Continued*)

SCALE OF POINTS	NAME OF BREED			
Ribs, deep, well sprung, closely set, thickly, evenly, and firmly fleshed Loin, broad, straight, thickly, evenly, and firmly fleshed Flanks, full, low	6 6 2			
Hind quarters — 20 points				
Hips, smoothly covered, proportionate width . .	3			
Rump, long, level, width well carried back, thickly, evenly, and firmly fleshed	5			
Thighs, deep, wide, well fleshed	4			
Twist, deep, broad, well filled	6			
Legs, straight, short, strong; shank, short but sound	2			
Fleece and skin — 11 points				
Quantity of wool, long, dense, even, well distributed over body	3			
Quality of wool, fine, soft, pure, even, crimp close and uniform	3			
Condition of wool, bright, strong, clean, yolk abund- ant	2			
Skin, pink color, clear	3			
Total	100			

CHAPTER IX

POULTRY

Origin and history of poultry.— It is generally believed that our domestic hen originated from the wild jungle fowls which still live in India, Ceylon, and the Philippine Islands.



FIG. 65.— The Aseel fowl, one of the original ancestors of domestic fowls.

This wild fowl was a game, wary, shy bird, about the size of a pheasant, weighing from a pound to three and one half pounds. The female jungle fowl usually laid two clutches of eggs a year, each containing from 2 to 15 eggs. These eggs were small and probably weighed from 4 to 8 ounces a dozen.

The wild fowl was a scratching bird, living on seeds, insects, and vegetation. It could fly some distance, and, after the young were large enough to fly, roosted on limbs of shrubs and trees. It was a game fowl, and its flesh had a wild, undomesticated

Note to the Teacher: The materials needed to do the Laboratory Exercises and Home Projects suggested at the close of this chapter are:

“The Standard of Perfection,” pure-bred fowls of the following breeds: Plymouth Rock, Wyandotte, Rhode Island Red, Orpington, and others. One sample of eggs (twelve eggs make a sample); scales that will weigh to ounces.

taste, and did not possess the good eating qualities of the meat breeds of our fowls to-day. Some people prefer the wild flavor and think that Leghorn chickens have a flavor like that of undomesticated birds.

Fowls were domesticated centuries ago by the Chinese. From China they were distributed through the rest of Asia, Europe, and America.

Up to 1850 little was done to develop and improve poultry breeds. Very primitive methods were used in the poultry industry. Methods of housing, feeding, breeding, and selection were neglected. Scarcely any one attempted to develop his poultry. Two practices greatly hindered its development: (1) The best fowls were slaughtered for table use, and (2) it was generally believed that a mixed flock produced the best results; consequently, no definite varieties were developed. The idea that a mixed flock of fowls are more productive is still held by many, but is not in keeping with the principle, "that for definite purposes, definite varieties are developed."

Since about the middle of the nineteenth century, definite breeds have been developed for specific purposes. Factors which have been influential in aiding the development of definite breeds were:

1. The interest of poultrymen in better poultry
2. Exhibitions
3. Poultry books and newspapers
4. Incubators (improved from 1890 on)
5. Instruction
6. The publication of "The Standard of Perfection"¹ (first copy published 1874)

¹ "The Standard of Perfection" is published by the American Poultry Association, Mansfield, Ohio. (Cost about \$2.) This book should be placed in every school in the land.

Importance of poultry. — The value of fowls raised and chicken eggs produced in 1919 was \$1,047,989,919, while the products of all kinds of poultry in 1909 were valued at \$509,195,232, representing an increase of \$538,794,687 or 105.8 per cent. The value of chickens raised and chicken eggs produced in 1919 constituted 39.3 per cent of the total value of live stock products; in 1909 the value of poultry was 43.2 per cent of the value of such products.

The seven states reporting the largest production of fowls and eggs in 1919 according to the Census Report of 1920 were the following:

	NUMBER OF FOWLS	DOZENS OF EGGS	VALUE OF POULTRY PRODUCTS
Iowa	27,750,000	120,697,000	\$70,212,000
Missouri	25,000,000	117,203,000	66,271,000
Illinois	25,000,000	105,757,000	67,690,000
Ohio	20,232,000	102,377,000	64,109,000
Indiana	16,700,000	83,101,000	52,765,000
Kansas	16,500,000	76,136,000	44,199,000
Nebraska	11,615,000	49,132,000	29,500,000

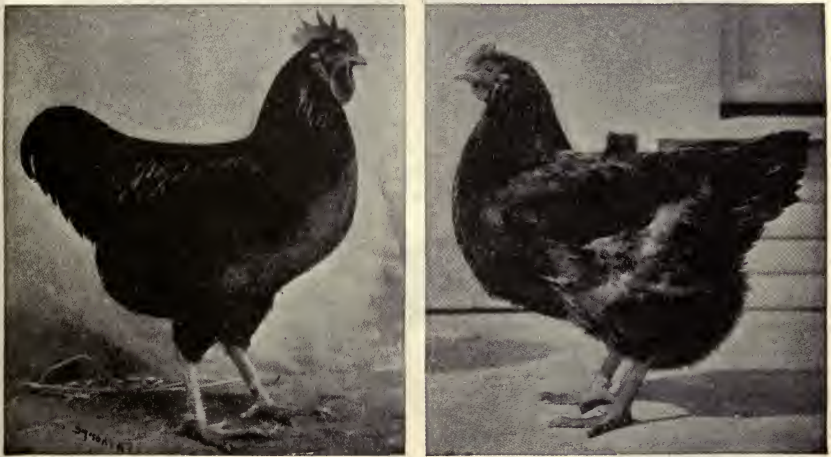
The poultry states and the corn belt states are the same.

The corn belt is composed of the states of Iowa, Illinois, Missouri, Indiana, Nebraska, Ohio, and Kansas. The above seven states produce over 40 per cent of all the fowls and eggs produced in the United States. The rest of the states produce not quite 60 per cent of the poultry products of the United States.

Classes, breeds, and varieties of poultry. — There are twelve classes of poultry. The term "class" usually refers to the country in which the fowls originated. The twelve classes are: American, Asiatic, Mediterranean, English, Polish, Hamburg,

French, Continentals, Games and Game Bantams, Orientals, Oriental Bantams, and Miscellaneous.

In each class there are usually several breeds; for illustration, in the American Class there are the following breeds: (1) Plymouth Rocks, (2) Wyandottes, (3) Javas, (4) Dominiques, (5) Rhode Island Reds, and (6) Buckeyes. Every breed has a different shape. Poultrymen frequently say, "shape makes the breed, and color the variety." To illustrate, all Rhode



Courtesy of University of Missouri.

FIG. 66. — Rhode Island Red male and female. The Rhode Island Reds are characterized by a straight back and rectangular appearance.

Island Reds are *bricklike* in shape; and all Wyandottes are *ball-shaped*. Rhode Island Reds have a long back and body; Wyandottes have a short back and body. Study the illustrations of hens and cocks of each. Hens and cocks of each breed have standard weights. The size, shape, and weights of fowls are closely related. Some people overemphasize color of plumage, but it should be remembered that, while color of plumage is worth



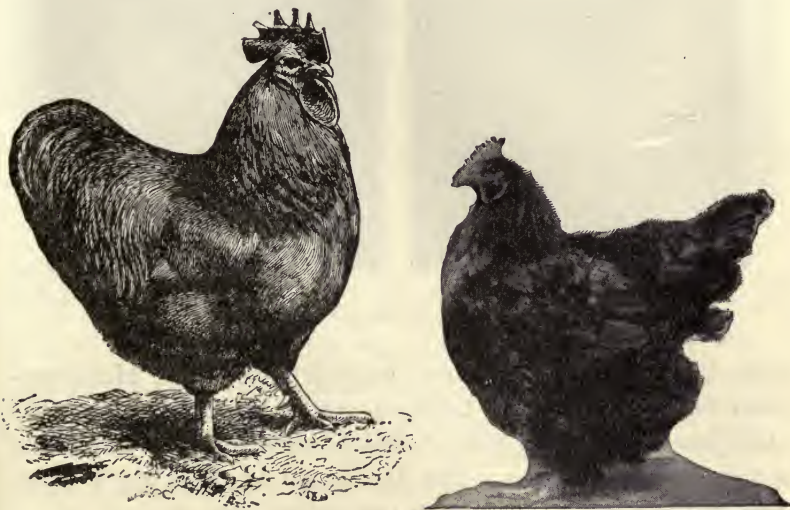
FIG. 67. — Barred Plymouth Rocks. Note the shape of these fowls. Plymouth Rocks are of six varieties, — Barred, White, Buff, Silver Penciled, Partridge, and Columbian. All varieties have the same weight, — cocks $9\frac{1}{2}$ lb., hens $7\frac{1}{2}$ lb.



Courtesy of University of Missouri.

FIG. 68. — Wyandotte male and female. Note their shape. They are ball-shaped and have a Rose comb. All varieties of this breed have the same shape and weight, — cocks $8\frac{1}{2}$ lb., hens $6\frac{1}{2}$ lb.

while, it is only a matter of secondary importance. If a fowl is to be most productive in egg or meat production, it must have the shape which is consistent with the purpose in mind. A very short back and body are not conducive to the highest egg or meat production. A fowl must have capacity of back and body in order to be a good egg or meat producer. Egg



Courtesy of University of Missouri.

FIG. 69. — Orpington male and female. While the Orpington has a back similar to the Plymouth Rock, its general appearance approaches that of the Wyandotte.

production and meat production have been the bases of development of most of our breeds of poultry.

As was stated above, "color makes variety." The Plymouth Rock Breed comprises six varieties, Barred, White, Buff, Silver Penciled, Partridge, and Columbian. The varieties have different colored plumage. In practically all other respects they are similar. Their shapes are identical. "The Standard of

Perfection " gives detailed descriptions of the shapes and colors of all varieties of fowls.

Purposes of poultry. — *Egg and meat production.* Three types of fowls have been developed: (1) the egg type, (2) the

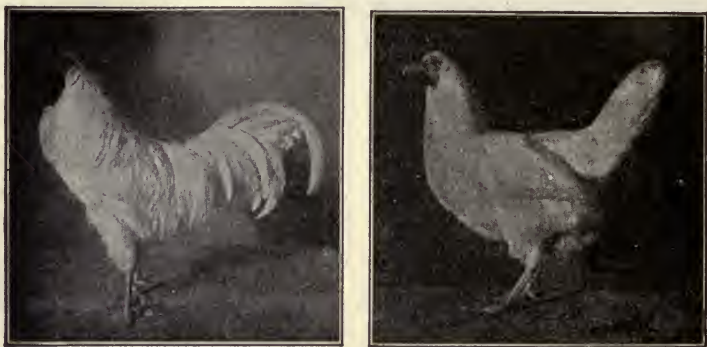
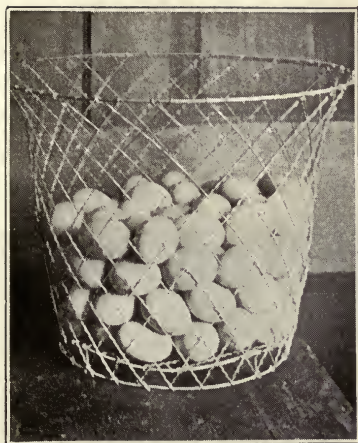


FIG. 70. — Single-comb White Leghorns. Note white ear lobe, and the snug way they hold their feathers.

meat type, and (3) the general purpose type. The Mediterranean Class, of which the Leghorns are a breed, conform most closely to the egg type. The Asiatic Class is generally considered a meat-producing type. The American Class and the Orpingtons of the English Class are of the general purpose type.

Since swine and beef cattle furnish, to a great extent, the meat supply for the American people, chickens are not raised extensively for their meat; although large quantities of poultry are sold annually for meat. The egg production in the United States, on the average, is nearly 60 eggs per hen per year. It is believed the average production could be raised to 120 eggs per hen. Since twelve eggs, if of fair size, weigh from 24 to 26 ounces, and the weight of the average hen is about five pounds, it will be seen that a hen would produce about three times her own weight in eggs a year.



60 eggs. What the average farm hen produces.



120 eggs. What she should produce.

FIG. 71.

EGG PRODUCTION¹

VARIETY OR NAME	NUMBER OF EGGS	WEIGHT OF EGGS IN OUNCES	WEIGHT OF HEN	WEIGHT OF FEEDS EATEN PER YEAR
			Pounds	Pounds
Plymouth Rock	165	351.45	6.25	91.8
Wyandotte	175	355.25	5.75	74.5
Rhode Island Red	167	374.08	5.98	91.5
Leghorn	165	348.15	3.60	71.3

It will be observed from the above table that the Leghorns produced a greater weight of eggs in proportion to the food consumed than any other breed. However, the conclusion should not be made from the above table that the Leghorns are the best

¹ Taken from Bulletin No. 10, Missouri State Poultry Experiment Station.

breed. About one third of the money derived from the sales of the poultry products comes from the sale of poultry for meat ; and about two thirds of the income comes from the sale of eggs.

Characteristics of a good fowl. — A good fowl should conform very closely to the standard weight and shape of the breed to which it belongs, and have the color of its variety. This



Courtesy of Mountain Grove Poultry Exp. Station.

FIG. 72. — Two chicks of the same age, raised in the same brooder and given the same feed. One is bred from vigorous, healthy stock and the other from stock lacking in vitality.

shows good breeding or improvement and indicates that its ancestors were pure bred fowls for at least six generations. A fowl should also show a good constitution. A strong beak, a broad head, a well-formed body, and strong legs indicate a good constitution. A fowl with a thin, peaked, snaky head should be

killed for meat. The posture and carriage of a fowl are worthy of consideration. Erectness, pride, alertness, and activity are characteristics of a good fowl. An active fowl is better. "Late to roost and early to rise, makes a fowl healthy, wealthy, and productive." A fowl that is lazy, droopy, and does not hold its feathers and body up snugly is not good. A fowl that works from early morning to late evening is the egg producer. Fowls that remain on the roost late in the morning, go to bed early at night, and sit on the roost a part of the day are drones and unworthy of their keep. The hens that go farthest from the house are usually the best layers.

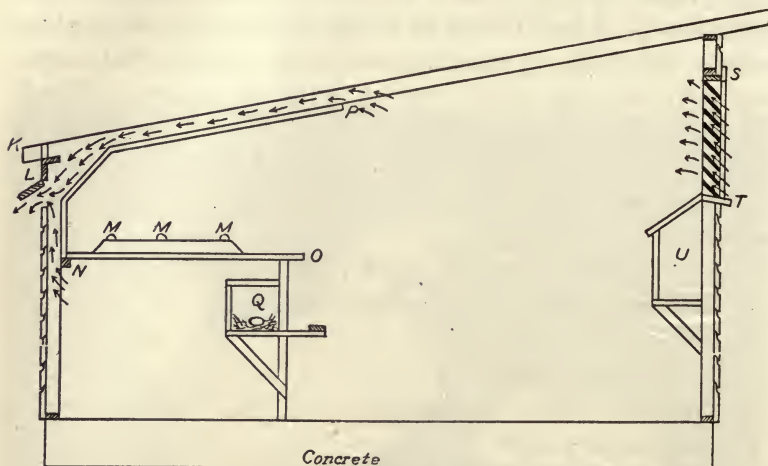
Other points which indicate good qualities in fowls are :

1. Early hatched and early maturing pullets
2. Early laying pullets
3. Winter laying hens
4. Fowls that do not go broody
5. Late molting fowls
6. Fowls with short, worn-down toenails

Housing of poultry. — *The essentials of a poultry house.* The essentials of housing poultry are :

1. The house must furnish sufficient room.
 2. It should be dry.
 3. It should be well ventilated, but free from drafts.
 4. Every part of the house should receive sunshine during the day.
 5. It should be sanitary and easily cleaned.
 6. It should be convenient.
 7. It should be economic in cost.
 8. It should be enemy proof.
1. Authorities agree that each fowl should have from 3 to 5 square feet of floor space. A house that has 400 square feet of floor space will house satisfactorily about 100 fowls. However

the floor space will vary somewhat with the kinds of fowls; the heavy Asiatics will require more room than the small Leghorns. A poultry house that is to serve as a roosting place alone need



Courtesy of Missouri Poultry Experiment Station.

FIG. 73. — A cross section of a convenient poultry house. *M* is a roost pole, *O* is the droppings platform, *Q* is the nest underneath, *L* is the back ventilator, *U* is the bin for the grain, *S* and *T* are the front ventilators.

not be as large per fowl as one that is to serve as a roosting, living, and laying house.

2. The poultry house should be built in a dry place and kept dry. A wet, moist house will be a cold house.

3. The house should be free from drafts, but should be well ventilated. Pure air is essential to poultry, but drafts cause sickness and reduce the strength of the fowls. Means for ventilation should also be provided when the house is built.

4. The sunlight should, if possible, strike every part of the house daily. The sun's rays keep the house dry and comfortable, destroy germs and lice, and give tone to the fowls. The kind of

windows and methods of admitting sunshine are discussed later.

5. A sanitary house, free from germs, odors, and lice, is essential. All interior fixtures should be movable. The walls should be free from crevices and openings. No hiding places for vermin should be allowed. The manure should be removed frequently.

6. Convenient arrangement of the interior of a poultry house reduces the cost of production. Roosts, nests, feeding hoppers, drinking pans, bins for holding feeds, should be conveniently located for the attendant.

7. Poultry houses should be economically constructed. A house suitable for 100 hens should not cost much more than \$60 or \$75. The lumber of old buildings may be used to reduce the cost. Square houses cost less than long houses. A simple house costs less and is better.

8. Rats, mice, and other animals should be kept out of the poultry house. There is much loss due to rats destroying young chickens. Minks and polecats also lay a heavy tax on poultry production.

Poultry house construction. — *Foundation.* There are two kinds of foundations for the sills to rest upon :

1. Wooden posts of hedge, oak, or cedar may be used for the foundation. These posts are set 2 or 3 feet in the ground, and 3 or 4 feet apart. A trench should be dug all the way around these posts, and a fine wire netting, extending 2 to 3 feet in the ground, should be tacked to the posts. This netting will keep out vermin. Brick or rock pillars may be used instead of wooden posts.

2. Cement foundations are put into the soil deep enough to prevent heaving by frost, and should extend 12 inches above the surface of the ground. Cement foundations give greater

protection from cold and destructive animals. They are more expensive but last longer.

Floors. There are three kinds of floors for poultry houses. Each has its advantages and disadvantages, according to conditions:

1. The earth floor is probably the best in places where the soil is sandy and dry, but should not be used in places where the soil is wet. An earth floor is hard to clean; a part of it is taken away at every cleaning, so that it soon becomes lower than the ground outside and the soil water drains into the house.

2. Board floors harbor insects, rats, and mice, are cold, do not last long, and therefore are not to be recommended.

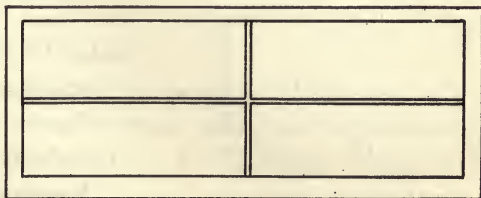
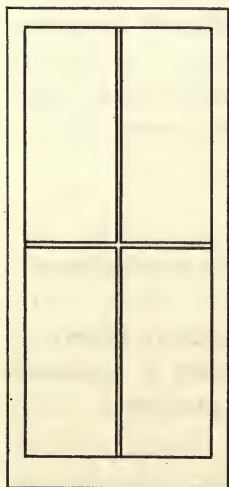
3. Cement floors, if properly made, are the best. In making a cement floor the following points should be observed: First, from 8 to 12 inches of coarse gravel, rocks, or cinders should be packed down to break the capillary movement of soil water, and to keep the house dry. The cement floor should be 8 to 12 inches above the surface of the soil. This will keep the house dry, especially if the soil outside is properly graded. The cement floor is durable and rat-proof and can be easily cleaned.

Walls. Walls are made of boards, brick, or cement. In most cases boards put on vertically are most satisfactory. Disinfection is difficult where boards are put on horizontally. The inside walls should be smooth. This aids in keeping the house sanitary.

Height of the house. The height of the poultry house depends upon the type of roof used. Ordinarily in a house with a semi-monitor roof the back should be about 5 feet high and the front about 7. In a house 16 feet wide, with a shed roof, the back should be about 5 feet and the front should be about $7\frac{1}{2}$ or 8 feet high.

Ventilation. Figure 73 illustrates how a house can be well ventilated without drafts. Notice the open shutters in front and the open end at the rear.

Windows. There should be about 1 square foot of window to every 15 square feet of floor space. A house that has 400 square feet of floor space should have about 27 square feet of



Windows set horizontally permit the sunlight to shine over only a small portion of the house.

FIG. 74. — Windows set vertically permit the sun's rays to shine over more of the floor space.

glass space to the south and have 3 or 4 small windows at the back. Tall windows are better than wide windows, for they admit the sunlight over a greater area. Windows should be kept clean to insure the maximum degree of light, warmth, and disinfection from the sun's rays.

The windows on the south side should be placed fairly high so that sunlight may strike the remotest corners. See cuts of houses on page 172.

Types of roofs. There are five types of roofs. From the figures it can be determined when each may be used to advantage. The pitch of roofs should range from a fourth to a third slope.



FIG. 75. — This is a shed roof.



FIG. 76. — This is a gable roof.

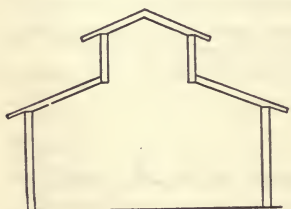


FIG. 77. — This is a monitor type of roof.

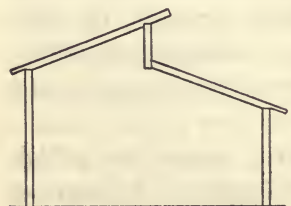


FIG. 78. — Semi-monitor roof.

1. Shed Roof

Advantages

Turns all the water to the back
Admits sunshine to all parts
Is the cheapest roof

Disadvantages

Cannot be used to advantage
in a house more than 16
feet deep

2. Gable Roof

Advantages

Can be used in a wider house

Disadvantages

Requires two sets of rafters
Does not admit a maximum
amount of sunlight

3. Monitor Roof

Advantages

When properly made may give
good ventilation and sunshine
May be used in a very wide house

Disadvantages

Requires four sets of rafters
Is more expensive

4. Semi-monitor Roof

Advantages

Admits light into all parts of
the house
May be well ventilated

5. Combination Roof

Advantages

Used in the open-front houses

Admits sunlight

Disadvantages

Is not as good as the semi-monitor



FIG. 79. — Combination roof.

Interior fixtures in poultry houses. — The essential points to consider in putting in interior fixtures are :

1. Cheapness of construction
2. Convenience to caretaker
3. Saving of space
4. Movability
5. Arrangement so that they may be easily disinfected
6. Adaptability to the breed of fowls raised

One or more of these points will be discussed briefly with each interior fixture mentioned.

Roosts. If the fowls are to stay in the poultry house overnight, roosts must be provided. Wild chickens roosted on the branches of trees. Round branches are not best suited for fowls to roost upon. An undue pressure is borne on the breastbone of the fowl when roosting on a rounded or edged surface. It is for this reason that crooked breastbones are found in chickens. Roosts are made most economically by using 2×3 inch or 2×4 inch lumber and slightly rounding the edges. They should be fitted on the sides so that they may be easily removed. A smooth roost aids in keeping out insects and in disinfection. All the roosts should be on one level, for when they are placed slantwise one above the other, like the steps on a leaning ladder, the fowls are constantly pushing each other off in order to get on the upper perch, and are often injured.

The amount of roost space needed depends on the size of the

fowls. Small breeds will need about 7 inches of perch room; medium breeds 9 inches; and large breeds from 10 to 12 inches. The rear perch should be about 12 inches from the wall, and the roost poles 14 inches apart. The height of the roosts also depends upon the kind of fowls. Light breeds can fly from a height of 4 or 5 feet without injury, but the perches for large breeds should not be more than 2 or 3 feet from the floor. If a droppings board is used, it should be at least 30 inches from the floor, so that the floor space underneath may be used. Roosts may be fastened to the walls with hinges so that during the day they can be fastened to the roof. This will keep the fowls from roosting during the day in winter time.

Scratching shed. If during the winter the fowls are to stay in the poultry house in the daytime, a scratching shed will aid in egg production, and keep the fowls in good condition. This shed should have an open front and be 15 × 15 feet. Twelve or fifteen inches of straw, with a little grain scattered through it in this shed, will keep the fowls active, warm, and busy during the cold winter days.

Nests. Fowls like a dark secluded nest for laying, so nests should be placed in the back part of the house. The nests should be movable and should be taken out, aired, and sunned occasionally. The size of the nests depends on the breed, from 10 × 12 to 12 × 14 inches. Trap nests are used when accurate records are wanted. These are made with a door that closes automatically when the hen enters the nest. Where an egg-producing strain is being developed, trap nesting is essential, for accurate records of each hen can then be kept. It is advisable that a slanting board be placed on top of trap nests to prevent fowls from roosting on them.

Feeding hoppers. Factories have turned out many kinds of feeding hoppers, but any farmer can construct them much more

cheaply. The capacities of hoppers vary from a few pounds to two or three hundred pounds. They are sometimes made with several compartments.



Courtesy of Mountain Grove Poultry Exp. Station.

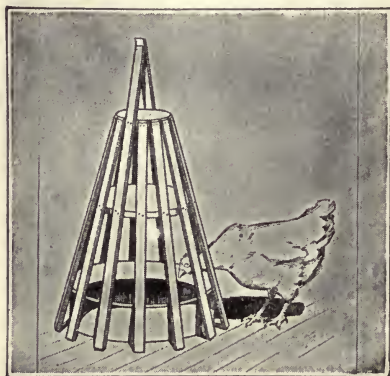
FIG. 80. — A dry-mash hopper, four and one half feet long, which holds over 150 pounds of dry mash. The opening through which the fowls eat should be four inches in the clear. Wires are placed across this opening three inches apart to prevent the birds from getting in and also prevent them from flipping the mash out. This shows the top door open ready for filling.

The main advantages of hoppers are :

1. They save labor.
2. Where several feeds are provided in the hopper, the fowls may balance the feeds according to individual needs.
3. Where fowls are fed in a flock, shy fowls seldom get enough feed. The feeding hopper supplies their needs. Hoppers should

be economically made, be hung in a well-lighted place, and their capacity range from two to three hundred pounds per hundred fowls. The kinds of feeds used in hoppers will be discussed under feeds and feeding.

Drinking pans. Drinking pans or buckets should be placed upon platforms about $1\frac{1}{2}$ or 2 feet high. The main consideration is to prevent dust, dirt, and filth from falling into the water.



Courtesy of International Harvester Co.

FIG. 81. — One way to keep the water clean. Fresh, clean, moderately warm water is as essential to egg production as food.

Fresh, pure water is essential to egg production, for about 66.7 per cent of the egg is water. The water should be pure and fresh, warm in winter and moderately cool in summer.

Dust wallows. Dust wallows should be about 10 inches deep, large, and preferably placed outside of the hen-house in a sunny spot. Dust baths are necessary to kill the lice and mites. Many lice are lost in the dust wallow, and

others inhale so much dust into their breathing openings (spiracles) that they die because of lack of air. Equal parts of fine road dust, sand, and ashes make an excellent dust wallow.

Eggs and egg production. The average annual farm income from eggs, according to the United States Census Report,¹ is \$99, and from chickens sold, \$44.40. About two thirds of the average farm income from poultry is from the sale of eggs. Egg production constitutes the principal part of the poultry industry; meat production is a by-product. If the estimates are correct

¹ 1920.

that the annual income from poultry is about \$1,047,989,919 in the United States, then the total egg values are approximately \$700,000,000. This is about equal in value to the total wheat products. Eggs in many homes pay for groceries and clothes. Many farmers consider poultry products a side line, but, in large numbers of cases, the sale of eggs is the mainstay for general running expenses.

Parts of an egg. An egg is composed of the shell, two membranes beneath the shell, an air sac between the membranes, three layers of the white, the germ, and the yolk. Examine an egg shell to find the two mem-

branes. An egg contains water, 66.7 per cent; protein, 12.2 per cent; ash, 12 per cent; fat, 8.9 per cent.

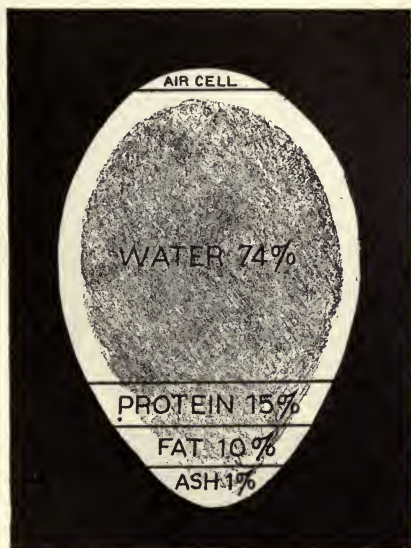


FIG. 82. — The composition of the edible portion of an egg.

COMPOSITION OF MILK AND EDIBLE PART OF EGGS

	WATER	FAT	SUGAR	PROTEIN	ASH
Milk	87%	3.69%	4.98%	3.5%	0.7%
Eggs	74.0%	10.0%	0.00%	15.0%	1.0%

Building of an egg. An egg is built in parts. Just as a knife is made a piece at a time, — the blade by one man probably, the part that holds the blade by another, and the handle by still

another, — so also is the egg made a piece at a time. There are three essential parts of an egg — the yolk, the white, and the shell. Each part is made in a separate part of the egg-laying organ.



Courtesy of Mountain Grove Exp. Station.

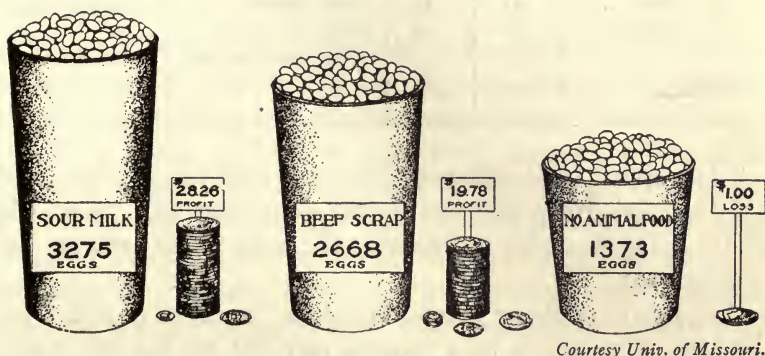
FIG. 83. — Photograph of the egg organs to show the sections where different parts of the egg are made.

The yolk is developed in the ovary; the white (albumen) is laid on the yolk in the first two thirds of the oviduct; and the shell is built over the white of the egg in the lower third of the oviduct. Each of the three parts of an egg is developed by a specialized organ.

The time required to build each part of the egg varies somewhat. But it may be generally stated as follows: All the yolks of the eggs that a fowl is ever to lay are developed in the growing fowl before it is 5 or 6 months old. These yolks are very small, ranging in size from that of a pinpoint up to the normal size as found in eggs.

It was found by an expert examination that these yolks in the grapelike ovary vary in number from 1500 to 3600. It is claimed upon good authority that more yolks are present in the fowl than can ever be laid. When the yolks mature, they pass into the oviduct where the white is laid over the yolk in three layers. The time required to do this is from 6 to 8 hours. The shell is made in from 12 to 24 hours.

Feeding for egg production. The egg is a finished product made up of parts. Before a knife can be produced, all the parts must be provided; so, also, in the making of an egg, every part must be provided before there can be an egg. No marketable egg is produced without a yolk, a white, and a shell. Therefore, in feeding for egg production, feed should be provided in such proportions that an equal number of yolks, whites, and shells



Courtesy Univ. of Missouri.

FIG. 84. — Sour milk for chicken feeding.

may be built. To supply feed in such a proportion to a hen as to build 50 yolks, 50 whites, and no shells, would mean no egg production; because no one has ever heard of a case in which 50 eggs having no shells were laid. After the feed for the production of 50 yolks and 50 whites has been supplied, feed that would have built 50 shells would have rounded out man's aid in giving the hen a chance to develop 50 eggs. To be successful in aiding the hen to develop eggs rapidly, one must realize that not all kinds of poultry food are well suited to egg production. Professor C. T. Patterson of the Mountain Grove Experiment Station has worked out the following way of balancing a feed for the maximum egg production. It is a suggestion worthy of our consideration.

AN UNBALANCED AND A BALANCED RATION

FEED	YOLKS	WHITES	FEED	YOLKS	WHITES
100 lb. corn . . .	255	134	100 lb. corn . . .	255	134
100 lb. wheat . . .	243	182	100 lb. wheat . . .	243	182
20 lb. oats . . .	39	31	20 lb. oats . . .	39	31
20 lb. bran . . .	31	41	20 lb. bran . . .	31	41
20 lb. shorts . . .	41	44	20 lb. shorts . . .	41	44
20 lb. cornmeal . .	50	29	20 lb. cornmeal . .	50	29
			20 lb. meatscraps .	20	221
Totals	659	461		679	682

“The above table assumes that one pound of carbohydrates will make $3\frac{1}{3}$ yolks and one pound of protein will make $16\frac{2}{3}$ whites. This is above maintaining the body where hens are fed all they want.”

Grit, oyster shells, or ground limestone should be provided for the hens, from which they provide material for the egg shells. To each one hundred pounds of the above feed about one and one half pounds of fine table salt and two pounds of fine charcoal should be added.

Under general farm conditions only two or three feeds will be used. In order to balance a corn ration, common poultry feed, it will prove economic to add one part of meatscraps to ten parts of corn. This will not quite balance the ration, for we will have the following :

	YOLKS	WHITES
Corn, 100 lb.	255	134
Meatscraps, 10 lb.	10	110
Total	265	244

Therefore slightly more than one tenth meatscraps should be fed. If skimmed milk is fed, the following may be used as a basis to figure its value: One hundred pounds of skimmed milk will make 22 yolks and 52 whites; and the same amount of buttermilk will make 22 yolks and 65 whites. Figure 84, taken from Bulletin No. 79, Agricultural Experiment Station, University of Missouri, illustrates what feed means in economic egg production.

Market grades of eggs. Eggs sold to the country stores should be fresh, clean, *infertile*, uniform in color, shape, and size, and should weigh from 24 to 28 ounces per dozen. All white eggs should be white. All brown eggs should have a uniform shade of brown. Unusually large eggs are undesirable, for they do not fit well into the fillers of egg cases, and are often broken. Eggs weighing 24 ounces are worth about 15 per cent less than eggs weighing 28 ounces. Why produce infertile eggs? Because hens will produce as many, if not more, infertile than fertile eggs, and infertile eggs are not affected by hot weather. Every egg should be covered with a shell of sufficient strength so that it will carry without breaking.

Preventable losses in market eggs. Circular No. 140 of the Bureau of Animal Husbandry states that the estimated average annual loss of eggs in the United States is about 17 per cent, or \$45,000,000. The distribution of causes for these losses is as follows:

	PER CENT
From dirties	2.0
From breakage	2.0
From chick-developed eggs	5.0
From held and shrunken eggs	5.0
From rotten eggs	2.5
From moldy and off-flavored eggs	<u>0.5</u>
Total	17.0

These losses can largely be prevented. Clean nests and daily gathering will prevent dirty eggs. Breakage can be reduced by shipping only eggs with a good shell and of a normal shape and size. Chick development can occur only in fertile eggs. Separating hens and cocks during the season that eggs are produced for the market will secure the production of infertile eggs, the only guarantee against chick development. All mature male birds should be killed, sold, or confined as soon as the hatching season is over. "Swat the rooster" after the breeding season will prevent the loss of many eggs. T. E. Quisenberry, of the Mountain Grove, Missouri, Poultry Experiment Station, states, "that the rooster spoils one-half million dollars' worth of eggs a month from June to October each year in Missouri alone." Harry R. Lewis, Poultry Husbandman of the New Jersey Agricultural Experiment Station, says in "Productive Poultry Husbandry": "There is probably nothing the poultryman can do which would improve the quality of eggs for table use as the production of infertile eggs." To prevent the loss due to heat and evaporation, eggs should be stored in a cool place. The losses due to decay may be partly prevented by marketing eggs twice every week, especially during the summer months.

Preservation of eggs. Since eggs are produced in greatest numbers in March, April, and May, it is often desirable to preserve some of the surplus supply for use the following winter. One of the cheapest and most convenient egg preservatives for farm use is made by adding one part of water glass (sodium silicate) to nine parts of rain water, well boiled and cooled. This solution is put into ordinary stone jars holding from 12 to 15 dozen eggs. The top of the eggs should be covered by at least two inches of the preservative. It is advisable to cover the jar with oilcloth, or something similar, to prevent evaporation. The jars should be kept in a place where the temperature is

about 60° Fahr. or cooler. Eggs may be kept in excellent condition by this method. The shrinkage of the eggs over a period of 9 months is often as little as one per cent. Preserving eggs is analogous to curing meats, canning fruits, and ensiling corn.

There are many other methods of preserving eggs, among which may be mentioned preservation in limewater and varnishing with vaseline. Eggs preserved in limewater are good, but they have often a disagreeable odor and taste; and to varnish eggs with vaseline takes too much time. If the eggs are fresh and the directions for the use of water glass are followed, the results will be satisfactory.

How to select hens that will lay. — Housing and feeding and exercise are all essential for egg production, but with the best of care and management these will not make all hens lay. Before eggs can be produced, there must be a hen of proper conformation. It has been found by the trap-nest system that some hens will never lay an egg. We have known for some time that some horses are race horses and others are draft horses. We also know that the most economic milk-producing cows have a dairy conformation, but it has only been recently known that a laying hen differs as much from a non-layer as a dairy cow differs from a beef-producing cow. Walter Hogan,¹ author of the Hogan Test, has discovered the characteristics that indicate egg production. To him we are indebted for the following established facts regarding egg-producing capacity (after all other factors have been provided):

1. *The measurement of the fowl* from the rear of the breastbone to the pelvic bone is very significant. If the distance is only

¹ "The Call of the Hen," by Walter Hogan, published by The American School of Poultry Husbandry, Mountain Grove, Mo., will be found helpful in poultry study.

one finger's width, the fowl will lay very few eggs; but if it is 5 or 6 fingers' width, the capacity of the fowl for egg production is greater.

2. The egg-producing capacity depends on the *thickness of the pelvic bone*, which includes the skin, muscles, and gristles. A thin pelvic bone indicates high capacity for egg production; but a heavy, thick pelvic bone indicates a low capacity. For illustration, a hen having one-finger capacity and a pelvic bone $\frac{1}{8}$ inch thick would be capable of producing 36 eggs the first laying year, provided all other factors for egg production were correct. But if she had a one-finger capacity and her pelvic bone was $\frac{5}{8}$ inch thick, she would be incapable of producing any eggs.

In view of the fact stated above that poultry and poultry products constitute so large a part of the output of the farm, the importance of this discovery cannot be overemphasized. In consequence of the application of the principle thus established, the farm poultry flocks can be reduced to the producers, which will result in the lowering of the cost of production. By proper mating the farm flock can be graded up to higher productive capacity, which will both increase the output and decrease the cost of production, thereby making greater gains for the farmer. The simplicity of the operation of the Hogan Test makes it intensely practical, and too much credit cannot be given to the agricultural schools and county demonstration agents for their part in disseminating its value and method. There is absolutely no excuse for wasting feed on hens that not only cannot lay but that cannot get any fatter or more ready for the market or the table.

The table on page 185 combines the main points of the Hogan Test. Every boy and girl should study it and be able to apply it.

THE RELATION OF THICKNESS OF PELVIC BONE AND CAPACITY TO EGG
PRODUCTION WHEN CONDITION IS GOOD

THICKNESS OF PELVIC BONE	1-FINGER CAPACITY	2-FINGER CAPACITY	3-FINGER CAPACITY	4-FINGER CAPACITY	5-FINGER CAPACITY	6-FINGER CAPACITY
Inches						With Nervous Temperament
$\frac{1}{16}$	36	96	180	220	250	280
$\frac{1}{8}$	32	87	166	205	235	265
$\frac{3}{16}$	28	78	152	190	220	250
$\frac{1}{4}$	24	69	138	175	205	235
$\frac{5}{16}$	20	60	124	160	190	220
$\frac{3}{8}$	16	51	110	145	175	205
						Slow Temperament
$\frac{7}{16}$	12	42	96	130	160	190
$\frac{1}{2}$	8	33	82	115	145	175
$\frac{9}{16}$	4	24	68	100	130	160
$\frac{5}{8}$	0	15	54	85	115	145
						Bilious Temperament
$\frac{11}{16}$		6	40	70	100	130
$\frac{3}{4}$		0	26	55	85	115
$\frac{13}{16}$			12	40	70	100
$\frac{7}{8}$			0	25	55	85
$\frac{15}{16}$				10	40	70
						Lymphatic Temperament
1				0	25	55
$1\frac{1}{16}$					10	40
$1\frac{1}{8}$					0	25
$1\frac{3}{8}$						10
$1\frac{1}{4}$						0

The capacity of any hen for egg production can be determined almost accurately from this table. To illustrate, a hen having a pelvic bone $\frac{1}{8}$ inch thick, and having a 5-finger capacity, will yield 250 eggs per year, when properly cared for. Temperament will affect the egg yield to some extent.

3. The *width between the pelvic bones* is also indicative of egg production. If there is very little space between the pelvic bones, the chances for egg production are few; but if the pelvic bones are wide apart, greater productivity is indicated.

4. The *condition of the fowl* raises or lowers chances for egg production. Condition is indicated by the covering of the keel of the breastbone. If the breastbone is well covered with flesh, the fowl is in good condition, which indicates, if all other factors are the same, high egg production. But if the breastbone is poorly covered, a lower yield of eggs may be expected than is indicated by the above numbers.

5. The *body quality* also has an important bearing on egg yield. Fowls with soft, pliable bodies, all other things being equal, produce more eggs than fowls with hard bodies.

6. In the yellow skinned varieties we may know by the *color* whether the fowl is laying, for the yellow pigment in the skin is deposited in the yellow of the egg, and in good layers most of the yellow pigment is lost from the body of the fowl in this manner. The yellow color disappears in regular order as follows: In a week or two the vent becomes light in color; in six weeks the color disappears in a heavy layer from the base of the beak; in 15 to 20 weeks the color of the shanks changes to a light color, and the last place to change to a light color is the elbow of the fowl.

The yellow pigment comes back into the vent, eye ring, ear lobe, beak, and shanks in the same sequence as it left, when the bird stops laying; only the color returns much more quickly than it went out.

A good layer is usually more gentle and docile when handled; but a poor layer usually squawks when caught.

7. A *broad, medium long, or long back* is essential to large egg production. Fowls with narrow, short backs have not enough

room for the digestive organs, heart, and lungs, and liver. Fowls with baggy bodies are not the best egg producers. The fat hen has a large deposit of fat in the abdomen, causing the abdomen to become baggy. In an active laying hen, the body is well held up, almost free from fat, and is on a level with the keel of the breastbone. C. T. Patterson says: "There is an old expression, 'Hens get too fat to lay,' which is incorrect. It should be said, 'The hen can't lay is the reason she gets too fat.'"

Capacity, thickness of pelvic bone, width between pelvic bones, condition of the fowl, body quality, color of yellow pigment, and a

broad, medium long back are essential characteristics of a good layer. The bright red color of the comb does not last long, and indicates that the fowl is either laying or will soon lay, but does not prove that a fowl is a good layer the entire year. The fact is that heavy laying soon takes the bright color out of the comb.

Egg-producing characteristics transmitted. — Since the male bird is at least half of the future flock, it is highly important that he possess the characteristics which are indicative of the ability to transmit high egg-producing characteristics. It is for this reason that we give the following table:



FIG. 85. — A hen of this type seldom is a good layer. She is inactive and has become so fat because she can't lay.

CAPACITY AND THICKNESS OF PELVIC BONES IN A MALE BIRD IN RELATION TO EGG-TRANSMITTING QUALITIES

THICKNESS OF PELVIC BONES	1-FINGER CAPACITY	1½-FINGER CAPACITY	2-FINGER CAPACITY	2½-FINGER CAPACITY	3-FINGER CAPACITY	3½-FINGER CAPACITY	4-FINGER CAPACITY
$\frac{1}{16}$ inch	84	132	180	200	235	257	280
$\frac{1}{8}$ inch	75	120	166	185	220	242	265
$\frac{3}{16}$ inch	67	109	152	171	205	227	250
$\frac{1}{4}$ inch	58	98	138	156	190	212	235
$\frac{5}{16}$ inch	50	87	124	142	175	197	220
$\frac{3}{8}$ inch	41	75	110	127	160	182	205
$\frac{7}{16}$ inch	33	65	96	113	145	167	190
$\frac{1}{2}$ inch	24	53	82	98	130	152	175
$\frac{9}{16}$ inch	16	42	68	84	115	137	160
$\frac{5}{8}$ inch	7	30	54	69	100	122	145
$\frac{11}{16}$ inch	0	19	40	55	85	107	130
$\frac{3}{4}$ inch		8	26	40	70	92	115
$\frac{13}{16}$ inch		0	12	26	55	77	100
$\frac{7}{8}$ inch			0	11	40	62	85
$\frac{15}{16}$ inch				0	25	47	70
1 inch					10	32	55
1 $\frac{1}{16}$ inches					0	17	40
1 $\frac{1}{8}$ inches						0	25
1 $\frac{3}{16}$ inches							10
1 $\frac{1}{4}$ inches							0

From the preceding table it may be observed that a cock bird having a pelvic bone $\frac{1}{4}$ inch thick and $2\frac{1}{2}$ -finger capacity represents a 156-egg type; but if his pelvic bone is $\frac{1}{16}$ inch thick, and his capacity is 4 fingers, then he represents a 280-egg type. Select only those cock birds which have a very thin pelvic bone and a large abdominal capacity, for they will transmit egg-producing qualities.

The American egg-laying contest associations have proved the following suggestions profitable in selecting hens that will produce a large number of eggs.

1. Keep the birds with large plump combs and wattles.
2. Keep hens with pale vents, pale beaks, and pale legs. They have proved to be good layers.
3. Keep the late molters.
4. Keep the pullets which mature quickly and start laying first. Those which start laying when less than 200 days old, or nearest that age, are the best layers if they have had the right care.
5. Market those which have been slow to feather or seem to lack vitality.
6. The skin of the best layers should be rather loose and flabby on the abdomen between the vent and the breastbone.
7. The pelvic bones must be thin, straight, flexible, and wide apart.
8. Market the hens which are bagging behind and which have a heavy, fat, thick abdomen, which hangs below the point of the breastbone.
9. Keep the hustlers and heavy eaters that go to bed late and with full crops.
10. Birds that have long toenails, that show no signs of being workers, are usually unprofitable.
11. Choose the bird with a broad back, a long body, and a stout build.
12. If a bird is not molting and yet has a small, dried-up comb, covered with a sort of whitish substance, or if the bird has thick or crooked pelvic bones, which will be found on each side of the vent and about the point of the breastbone, she is a money loser.

Poultry diseases. — Prevention of poultry diseases is more important than curing them. There are two factors essential in preventing poultry diseases. These are breeding and raising chickens that have good vigorous constitutions; and sanitary

measures. Fowls that lack constitution succumb to diseases much more easily than do strong, vigorous fowls. If the poultry house and poultry yards are kept clean, most of the poultry diseases will be prevented. Uncleanliness favors disease. There are so many diseases to which poultry are subject that it would require a separate book to treat them all. A few diseases and enemies of poultry will be mentioned. Write to your state experiment station for information on diseases that may now be troubling your poultry; and to the United States Department of Agriculture for further suggestions.

Scaly leg is caused by a small mite that gets under the scales of the shanks of the fowls. The symptom of the disease is



Courtesy of J. B. Lippincott Co.

FIG. 86. — The work of the scaly leg mites.

an enlargement of the shanks, usually just above the toes. To treat this disease, dip the shanks in kerosene. This kills the mites. Repeat the treatment in about a week. Two treatments are enough, except in rare cases.

Roup is a contagious disease which appears on the face of the fowl in the form of a tumor. Often the eyes are almost swollen shut.

There is a discharge from the nostrils which sometimes obstructs the breathing. In treating this disease, isolate all the fowls affected. With the thumb press all cheesy matter out of the tumor, and dip the part affected in kerosene. Bulletin

No. 530, United States Department of Agriculture, says, "Put sufficient permanganate of potash in all drinking water to color it a deep red." This is a cure as well as a prevention of roup. Some authorities claim that roup is one of our most injurious poultry diseases.

Lice and *mites* are controlled by keeping the house clean and spraying occasionally with a lime solution, or greasing fowls with equal parts of lard and kerosene. Insect powders will also kill lice and mites.

Summary. — The products from chickens rank favorably with other sources of farm incomes. The income from poultry products in many cases provides groceries, shoes, and clothing. The selection of good pure bred varieties, according to "The Standard of Perfection," proper housing, feed, and care increase the sales from poultry products. Eliminating non-layers and low producers raises production. Cleanliness and combating disease are essential to profitable production of poultry. The average yearly egg production in the United States is estimated to be about 60 eggs per hen. It should be 120 or more.



FIG. 87. — The common hen louse.

LABORATORY EXERCISES AND HOME PROJECTS

1. With "The Standard of Perfection" in hand, study the pictures of the various breeds of chickens as to shape, kind of comb, length of back, angle of tail, etc.
2. With fowls of several pure breeds verify the shape differences noted in Exercise 1, and as described in "The Standard of Perfection."
3. Study from live fowls the color of one or two pure bred varieties,

reading the description of the variety from "The Standard of Perfection," while the fowl is being studied.

These three exercises, if properly done, will require at least five full one-hour periods. When these lessons are attempted, the teacher should have, for each one, at least an hour to one and one half hours at her disposal.

4. Judge at least one fowl from several varieties, using "The Standard of Perfection," and especially that part in which cutting for defects and general disqualifications are mentioned.

SCORE CARD FOR DIFFERENT CLASSES OF FOWLS
(Note their variations)

SECTION OF FOWL	AMERICAN CLASS		ASIATIC CLASS		MEDITERRANEAN CLASS		ENGLISH CLASS	
	Perfect		Perfect		Perfect		Perfect	
	Shape	Color	Shape	Color	Shape	Color	Shape	Color
Symmetry	4		4		4		4	
Weight	4		4		4		4	
Condition	4		4		4		4	
Comb	8		8		10		8	
Head	2	2	2	2	2	4	2	2
Beak	2	2	2	2	2	2	2	2
Eyes	2	2	2	2	2	2	2	2
Ear lobes and wattles	2	2	2	2	4	6	2	2
Neck	4	6	4	6	3	5	4	4
Wings	4	6	4	6	4	6	4	6
Back	5	5	6	4	5	5	6	4
Tail	5	5	5	5	5	4	6	4
Breast	5	5	6	4	4	4	6	4
Body and fluff . . .	5	3	5	3	3	2	5	3
Legs and toes . . .	3	3	3	3	2	2	5	3
Total		100		100		100		100

5. Have the pupil bring an estimate as to the cost of construction and building material of some poultry houses, giving dimensions, etc. Be definite.

6. Have the pupils bring the following data and record them in a notebook in the following form :

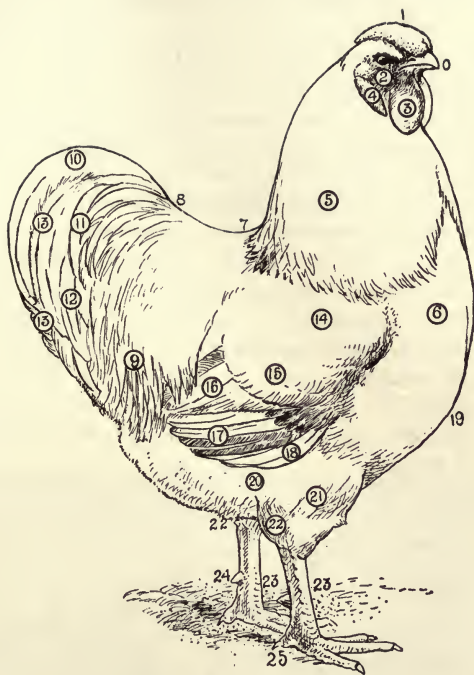


FIG. 88. — Parts of a fowl.

- | | | |
|--------------|-------------------------------------|--------------------------|
| 0. Beak. | 9. Saddle feathers. | 18. Flight coverts. |
| 1. Comb. | 10. Sickles. | 19. Point of breastbone. |
| 2. Face. | 11. Lesser sickles. | 20. Fluff. |
| 3. Wattles. | 12. Tail coverts. | 21. Thigh. |
| 4. Ear lobe. | 13. Main tail feathers. | 22. Knee joint. |
| 5. Hackle. | 14. Wing bow. | 23. Shank. |
| 6. Breast. | 15. Wing coverts, forming wing-bar. | 24. Spur. |
| 7. Back. | 16. Secondaries, wing bay. | 25. Toes, or claws |
| 8. Saddle. | 17. Primaries, or flight feathers. | |

POINTS TO BE OBSERVED IN SOME POULTRY HOUSES

KIND OF FOUNDATION	KIND OF WALL AND DESCRIPTION	KIND OF ROOF	PROVISION FOR VENTILATION	AMOUNT OF FLOOR SPACE	AMOUNT OF GLASS SPACE	HEIGHT IN REAR, FRONT, ETC.

7. Judge eggs according to egg score card. One dozen as a sample.

EGG SCORE CARD

SCALE OF POINTS	PERFECT	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED	STUDENT'S	CORRECTED
1. Weight	24								
2. Uniformity of size	6								
3. Uniformity of shape	6								
4. Uniformity of color	8								
5. Shell texture	4								
6. Condition of shell	4								
7. Quality (candling)									
1. Size of air cell	24								
2. Interior color	24								
Total	100								

Explanation of Score Card.

1. *Weight.* — 24 Points. — Extras weigh 26-28 and firsts 24-26 ounces per dozen. Cut 2 points for each ounce under or over weight in either class.

2. *Uniformity of size.* — 6 Points. — All eggs should be uniform in size. One half point is allowed each egg. For each egg varying from the average size, cut according to judgment.

3. *Uniformity of shape.* — 6 Points. — All eggs should be uniform in shape. For each egg varying markedly in shape, cut from one fourth to one half point.

4. *Uniformity of color.* — 8 Points. — White eggs should be of a uniform white shade. Brown eggs may vary in shade; but all eggs of a sample

should be of the same shade. Two thirds of a point is allowed for each egg. Cut according to judgment.

5. *Shell texture.* — 4 Points. — The shell should be free from spots, breaks, wrinkles, and roughness. Cut one third of a point for each egg showing the above defects.

6. *Condition of shell.* — 4 Points. — Shell should be bright, fresh, unwashed, free from dirt or stain. Cut according to judgment. One third point allowed each egg.

7. *Quality (candle eggs).*

1. *Size of air cell.* — 24 Points. — Test eggs with candle, kerosene lamp, or electric light. Air cells should be small, not larger than a dime, showing freshness. Two points are allowed for each egg. An egg showing an air cell as large as a quarter, cut the limit, two points. Cut for intervening sizes of air cells according to judgment.

2. *Interior color.* — 24 Points. — The interior color when candled should have a reddish color. An egg having a dark color or a floating yolk is defective. Two points are allowed each egg. Cut according to judgment.

Disqualifications. — A broken, cracked, musty, chick-developed, floating-yolked, or blood-ringed egg will disqualify the whole dozen.



Courtesy of International Harvester Co.

FIG. 89. — A dozen eggs should weigh from 24 to 28 ounces.

8. Weigh the same dozen eggs weekly for eight or ten weeks, and keep the weekly weights. Find at the close of the experiment the per cent of loss. (This loss is due to evaporation.)

9. Examine fowls according to Hogan Test for capacity, thickness of pelvic bone, condition, — and fill a miscellaneous column, including a statement on width of back, constitution, etc. Record your findings. What is the capacity of each hen examined for egg production?

10. Make a survey of the poultry in the district. — Record as follows.

FARMER'S NAME	VARIETY OF FOWLS	CLASS TO WHICH THEY BELONG	BREED	NUMBER

CHAPTER X

MARKETING LIVE STOCK

Marketing unfinished live stock. — The producer of live stock is interested not only in the production of good live stock, but also in getting the live stock to the market in the best condition possible. The consumer also has an interest in this problem. The animals marketed should be not merely free from disease but in the very best of health, having every organism in perfect condition. Besides this, they should show a reasonable degree of finish.

One of the greatest losses to farmers arises from the fact that poor quality stuff is pushed upon the market, — stuff that is unfinished and unclassified, and must be shipped and hauled four more times before it is ready for the block. It can be sold only as stockers and hence is shipped out to some farmer and he in turn must haul it back to the station and ship it again to market. Who pays the bill for all of this unnecessary work? No one could expect any one to pay it except the responsible party and that is the farmer. The railroads could be expected to do nothing other than collect the cost of transportation justly due them, and the consumer cannot be expected to pay for something he does not get.

If inferior stock is sold inferior prices should be expected. If medium stuff is sold medium prices should be expected. But if good stuff is sold good prices may be expected.

Fluctuation in prices often confusing. — There are some factors relative to the marketing of live stock which are very perplexing and over which the farmer has little or no control:

(1) What day or what month shall the farmer sell his live stock so that he may realize the highest profits? No one knows just when the best prices will prevail. Therefore no one can predict with surety just when to get into the game, and when to get out. No one can predict just what the prices will be on hogs, for illustration, because the governing factors are many and varied. Hog prices are governed to some extent by the corn yield, by the number of hogs and cattle in this and other countries, by the crop conditions, and also by the amount of meat in cold storage. (2) Again the real value of a dollar has its effect upon the price of hogs. During the World War the American dollar was worth 43 cents at one time and hogs sold for about 24 cents a pound. What is the difference to the farmer if he gets 12 cents for his hogs and a dollar is worth 86 cents, or he gets 24 cents a pound and the dollar is worth 43 cents? The best thing he can do is to sell when the stuff is high and buy when it is low. (3) Constant employment of the laboring man, and a steady money income will increase perceptibly the meat consumption of the country. Prosperity in foreign countries, which is not under the control of any one, will increase the demand for exports of meat products.

Therefore, all in all, the marketing of live stock is rather complex and there are many factors which are not under control which may affect the price on live stock.

There are three things, however, which will assist the farmer to a certain extent in marketing his live stock. These we will state in the form of three simple precepts:

1. Know your markets.
2. Know the market classes and grades of live stock.
3. Know the principles underlying coöperative marketing.

1. *Know your markets.* For every producer of live stock to know his markets helps him, helps the distributor, and helps

the consumer. A knowledge of the markets helps the producer because then he can distribute his products to the place where there is the best demand for them. This increases the price to the producer. It helps the distributor because it means a more widespread and even distribution of his products. And it helps the consumer because it means that the products are at hand to meet his needs.

How may a farmer know his markets? The daily newspaper is a fair source of information although usually a little late. Reading the paper regularly should give pretty good information regarding markets. Then again *The Market Reporter* is a fine source from which to gather information regarding prices on live stock. This is an impartial report dispatched in a 110-word newsletter to all of the important newspapers throughout the United States. The Government sends out daily reports on the fresh meat supply in the leading markets, and the live stock shipments, with their sources and their destinations and monthly reports of the supply of meats in storage by the large packers. Besides this the live stock movements in grazing and feeding sections are reported. All of these services by the Government are very valuable in keeping people informed regarding their live stock markets. Chicago is the largest live stock market in the world, and the live stock reports from Chicago are dispatched over the corn belt states in a very short time. The nine leading live stock markets in the order of their importance are: Chicago, Kansas City, Omaha, St. Louis, St. Joseph, Sioux City, St. Paul, Indianapolis, and Fort Worth. It is now possible to keep in pretty close touch with these markets through such publications as: *Chicago Daily Drovers Journal*, Chicago; *Daily Drovers Telegram*, Kansas City; *Daily Drovers Journal-Stockman*, Omaha; *National Live Stock Reporter*, St. Louis (National Stock Yards, Ill.); *Stock Yards Daily Journal*, St.

Joseph; *Sioux City Live Stock Record*, Sioux City; *South St. Paul Daily Reporter*, St. Paul; *Indianapolis Daily Live Stock Journal*, Indianapolis; *Fort Worth Daily Live Stock Reporter*, Fort Worth.

The U. S. Yearbook of Agriculture is a good source from which to gain information regarding the number of live stock in each state and the country as a whole. This information is valuable in getting an idea of the supply of the entire country. This may indicate to a farmer whether or not it will be advisable to enter into a certain type of live stock production.

An international report, sent out quarterly, for illustration, and reporting the live stock situation in all the principal live stock producing countries, would do much in stabilizing live stock production and live stock prices.

It pays to know where the need is. This is the chief function of agricultural market information. Its purpose is to regulate the flow of farm products to meet the demand. Often one town is overstocked and another one understocked. A Maryland farmer who had always marketed his potatoes in Baltimore found that Baltimore was overstocked and Philadelphia had few or no potatoes. He shipped his potatoes to Philadelphia and made \$250 by so doing. At other times the price on potatoes may be just the reverse in these two cities. A knowledge of markets will help in the proper distribution of commodities. An understocked market in one place and an overstocked market somewhere else is hardly conducive to the best economic and financial welfare of the nation, and with abundant supplies there is no good reason why such a condition should exist.

2. *Know the market classes and grades of live stock.* A knowledge of the market classes and grades of live stock helps much in marketing live stock. Corn, wheat, and oats are well classified and the market grades are fairly well understood by the

farmers. This is true because farmers handle and sell grains more commonly than they do live stock. But live stock, too, is fairly well classified and graded by the markets of the United States.

Where buyer and seller cannot agree as to a market class or grade, it is well that some authoritative and competent person be referred to in order to avoid trouble and controversy. That the student may know the usual classifications we shall give the market classes and grades of live stock and live stock products.

MARKET CLASSES AND GRADES OF HORSES AND MULES

SUBCLASSES		HEIGHT	WEIGHT
		Hands	Pounds
Draft horses	Light draft	15 $\frac{3}{4}$ 16 $\frac{1}{2}$	1600-1750
	Heavy draft	16 17 $\frac{1}{2}$	1750-2200
	Loggers	16 $\frac{3}{4}$ 17 $\frac{1}{2}$	1700-2200
Chunks	Farm chunks	15 15 $\frac{1}{2}$	1200-1400
	Southern chunks	15 15 $\frac{3}{4}$	800-1250
	Eastern chunks	15 16	1300-1350
Wagon horses	Expressers	15 $\frac{3}{4}$ 16 $\frac{1}{2}$	1350-1500
	Delivery horses	15 16	1100-1400
	Artillery horses	15 $\frac{1}{4}$ 16	1050-1200
	Fire horses	15 17 $\frac{1}{2}$	1200-1700
Carriage horses	Coach	15 $\frac{3}{4}$ 16 $\frac{1}{4}$	1100-1250
	Park horses	15 15 $\frac{3}{4}$	1000-1150
	Cab	15 $\frac{1}{2}$ 16 $\frac{1}{4}$	1050-1200
Road horses	Runabout	14 $\frac{3}{4}$ 15 $\frac{1}{2}$	900-1050
	Roadster	15 16	900-1150
	Five-gaited	15 16	900-1200
Saddle horses	Three-gaited	14 $\frac{3}{4}$ 16	900-1200
	Cavalry horses	15 15 $\frac{3}{4}$	950-1100
	Polo ponies	14 14 $\frac{1}{2}$	850-1000
	Mining mules	12 16	600-1350
	Cotton mules	13 $\frac{1}{2}$ 15 $\frac{1}{2}$	750-1100
	Sugar mules	16 17	1150-1300
	Farm mules	15 $\frac{1}{2}$ 16	900-1250
	Draft mules	16 17 $\frac{1}{2}$	1200-1600

Each subclass is further divided into the following grades: choice, good, medium, common, and inferior. A horse to grade as choice must approach the most perfect type, must show finish, quality, style, and action.

Beef cattle on the Chicago market are classified as follows:

MARKET CLASSES AND GRADES OF BEEF CATTLE

CLASS	GRADES
1. Beef cattle . . .	Prime, choice, good, medium, common, inferior
2. Butcher stock . .	Prime, choice, good, medium, common, inferior
3. Cutters and canners	Prime, choice, good, medium, common, inferior
4. Feeders	Prime, choice, good, medium, common, inferior
5. Veal calves . . .	Prime, choice, good, medium, common, inferior

Prime cattle comprise the best grade of any class, and inferior ones are the poorest specimens of any particular class. Cattle graded as prime may sell for 8 cents a pound, while those graded as inferior may sell for 3.5 cents a pound.

MARKET CLASSES AND GRADES OF SHEEP

SUBCLASSES	GRADES
Mutton sheep	Lambs . . Prime, choice, good, medium, and culls
natives and	Yearlings . Prime, choice, good
Western sheep	Wethers . Prime, choice, good, common
	Ewes . . Prime, choice, good, medium, and culls
	Bucks . . Choice, good, common
Feeders	Lambs . . Fancy selected, choice, good, medium, inferior
	Yearlings . Choice, good, and common
	Wethers . Choice, good, medium, and common
	Ewes . . Choice, good, medium, and common
Breeders	Ewes . . Fancy selected, choice, good, and common
	Bucks . . Good and common
Miscellaneous	Hothouse lambs . Good and common
	Export sheep . Good and common

Thus there are the following grades of lambs: prime, choice, good, medium, and culls. They vary in price from the highest to the lowest. Often culls are almost unsalable.

The market classes and grades of wool are as follows:

Wool is classified as combing or clothing wool. Combing wool is longer than clothing wool. Clothing wool is made into woolens, felts, and fabrics. The threads are not parallel and in fact the more they run in every direction the better it is, while the threads in combing wool must be parallel in the fabric. Combing wool is more valuable, bringing 3 to 6 cents more per pound, and is used in the manufacture of the finest worsted goods.

Bulletin 206, U. S. Department of Agriculture, gives the following interesting facts about the market classes and grades of wool:

MARKET CLASSES AND GRADES OF WOOL

COMBING WOOLS	SOURCE
Half blood	Delaine and Merino
Three eighths blood	Merino and Middle wool breeds
Quarter blood	Hampshire, Shropshire, Dorset, and Oxford
Low quarter	Mixture
Braid	Coarsest combing wool

CLOTHING WOOL

XX, wool from sheep that were washed before shearing

Half blood

Three eighths blood

Quarter blood

The last three terms were used to refer to wool from sheep of half, three eighths, and one quarter blood Merino; but these terms do not apply at the present time.

A good wool must be true to structure; that is, it must not contain wool of a different color or threads that lack uniformity in the strength of the fiber. A good wool must be strong and have no weak places in the fiber. Weak places in the fiber are caused by sickness and underfeeding. A good wool must be uniform in size of fiber. If the fibers are not the same size, the threads will break readily. Good wool should be reasonably clean and contain no burs or other matter that will interfere with its combing qualities. Black fleeces are not wanted because they do not take various kinds of dye colors readily.

There is some variation in the classification of hogs at different markets. These classifications may be had by securing the live stock papers from the leading hog markets. For our information at the present time it will suffice to give the market classes and grades of hogs of the Chicago market.

MARKET CLASSES AND GRADES OF HOGS

CLASS	GRADES
Mixed packing, uneven weights averaging 240 to 350 pounds	Common, medium, good
Heavy packing, 350 to 500 pounds . .	Rough, fair, good
Medium and mixed butchers, more even weights averaging 200 to 300 pounds .	
Light weight, 160 to 200 pounds . . .	Common, medium, good, choice
Selected packing and shipping, 150 to 300 pounds	
Pigs, 70 to 120 pounds	Inferior, fair, good, fancy
Feeding pigs, 70 to 140 pounds . . .	Medium, good, choice
Stags, any weights	Common, fair, good
Boars, any weights	Common, fair, good

Prime hogs show the highest finish and bring good prices. Choice hogs are not quite equal to prime hogs, and good hogs are

the next grade below choice. Poor and rough hogs are the least desirable grades.

Poultry and eggs are also classified. Fowls are classified by the markets as follows :

MARKET CLASSES AND GRADES OF CHICKENS

CLASS	GRADES	SIZE	SUBGRADES
Broilers . . .	{ Small	12 oz.	Firsts, seconds, culls
	{ Medium	1½-2¼ lb.	Firsts, seconds, culls
	{ Heavy	2¼-3 lb.	Firsts, seconds, culls
Roasters . . .	{ Small	4-6 lb.	Firsts, seconds, culls
	{ Large	6-10 lb.	Firsts, seconds, culls
Friers . . .	{ Small	2½ lb.	Firsts, seconds, culls
	{ Medium	3 lb.	Firsts, seconds, culls
	{ Large	3½ lb.	Firsts, seconds, culls
Capons . . .		6-8 lb.	Firsts, seconds, culls
Hens . . .	{ Heavy	Over 3½ lb.	Firsts, seconds, culls
	{ Small	Less than 3½ lb.	Firsts, seconds, culls

Thus in the class of broilers there are three grades; namely, squab broilers, medium broilers, and heavy broilers. Each grade of broilers is divided into three subgrades, firsts, seconds, and culls. Broilers derive their name from the fact that they are usually cut in half and broiled. This class is usually marketed at six to twelve weeks of age. The small broiler is in greatest demand. Roasters are usually marketed when three to four months old.

Eggs, too, are classified. In the first place they are classified as brown eggs or white eggs. All white eggs should be pure white. Brown eggs vary in shade, but whenever a sample is selected the individual eggs of the sample should all have the same shade of brown.

Eggs are classified as follows :

		WEIGHT
As to size	1. Extras	26 oz. or above
	2. Firsts	24-26 ounces
	3. Seconds	22-24 ounces
	4. Thirds	20-22 ounces
	5. Culls	Less than 20 ounces
Summer classification	1. No heat shown	
	2. With light floats	
	3. With dark floats	
	4. With blood rings	
Breakage	1. Blind checks	
	2. Checks	
	3. Dented	
	4. Cracks	
	5. Leakers	
Classification due to age	1. Held eggs	
	2. Rots	
	3. Having odor	
Classification on basis of cleanliness	1. Dirty	
	2. Washed	
	3. Smeared	

If eggs are absolutely fresh, clean, and uniform in shape and color, if they have a good shell texture, and if they weigh 26 ounces to the dozen they are classified as extras; if they weigh 22 ounces and come up to the other standards above mentioned they will be classified as seconds.

A brown egg is no better than a white egg; but some markets prefer brown eggs while other markets prefer white eggs.

Fertile eggs deteriorate as rapidly in summer as does milk, and hence the statement that only infertile eggs should be produced for human consumption cannot be overemphasized.

3. *Know the principles underlying coöperative marketing.*
There are at least six benefits derived from coöperative marketing :

1. Capital invested in coöperative organizations makes a saving and profit for the farmer, whereas otherwise these profits go to other investors or private organizers.

2. A community which markets a product that is renowned both in quality and quantity soon establishes a reputation for itself which induces buyers to come to that community for that commodity.

3. Through coöperation the needs of the community can be better and more economically supplied. That is, feed, machinery, coal, twine, etc., can be purchased more cheaply in large quantities than in small quantities.

4. Coöperative marketing through a competent leader educates its membership as to the demands of the market and as to the market classes and grades of products most desired.

5. Coöperative marketing leads to a greater and better community spirit which manifests itself in better social, educational, and religious endeavors.

6. Coöperative marketing results in greater net returns to the farmer for he receives the actual market price for his stock less the cost of marketing. The purpose of coöperative marketing is for savings, not for profits.

Factors essential in coöperative marketing. — There are some factors which are very helpful and almost fundamentally essential to success in coöperative marketing organizations. Some of the more important ones will be briefly discussed :

1. The production of a well-classified, high quality product is one of the essentials to success in a coöperative organization. To illustrate, the Danish farmers market their hogs in a coöperative way. They use for the most part one breed of hogs ; namely, the large Yorkshire hog, which is a white hog and dresses out a beautiful white carcass. The Danish farmers have an agreement to feed their hogs in a definite, well-understood way, and

market them when they weigh from 175 to 225 pounds on foot. This insures a uniform quality product. The trade-mark, "Wiltshire Sides," a name given to the entire half of the hog produced by the Danish farmers, stands for quality throughout the hog markets of the world, but the product is especially well known in England. The production, killing, curing, and marketing of the Wiltshire Sides by the Danish farmers is under a strict coöperative organization.

2. A real spirit of coöperation is essential to success in a co-operative marketing organization. Farmers who really coöperate will agree with their coöperating friends on what kind of product to produce and when to produce it. They will stand by the organization when it is flourishing and will not forsake it when it is having a little trouble. Just as an individual will have his ups and downs, so will a group also have its ups and downs in marketing its products. Even a State or National Government, which never attempts to make money but does attempt to save money, does not always flourish financially. Therefore, a coöperative marketing concern should not be expected to solve all the difficulties of marketing because this high result has never been attained by either a private or a group organization.

3. An efficient manager is absolutely essential in a coöperative marketing organization. He must be a man of experience and of the utmost honesty and must possess the qualities of leadership. An efficient manager is worth a good salary and it is here that a high salary results in savings ordinarily.

4. A simple system of bookkeeping is essential also to success. There is an accounting system put out by the Bureau of Markets, United States Department of Agriculture. This standard system of accounting is widely used and is probably the best system in use. Books should be audited by an expert accountant once a

year. This not only authenticates the books of the manager but begets confidence in the farmer coöperators.

5. A live board of directors will aid much in directing the affairs of the organization. This body with the manager really establishes the policy of the organization.

6. Size of business is an important factor in determining whether or not a coöperative organization can live. A large association insures more frequent shipments, better service, and a competent manager. An association which ships at least 150 to 200 carloads a year can render good service and can usually secure a capable manager. Some associations are so small that they cannot render good service, and they ship so infrequently that the farmers are not accommodated. No one questions the service that can be rendered by coöperative marketing associations, — but a coöperative marketing association will surely fail under ordinary conditions unless a fairly large-sized business can be depended upon.

The Rochdale Pioneer Plan which has proved to be a good system for coöperative organizations sets forth four principles which may be well incorporated as underlying principles in the management of the organization. These principles are: (1) one man, one vote; (2) the shares should be limited; (3) dividends and profits should be distributed on the basis of patronage; and (4) speculation is undesirable and almost invariably leads to ruin.

Summary. — Much unfinished live stock is marketed by the farmers of the United States. This results in losses to the farmer, the middleman, and the consumer. A thorough knowledge of the market classes and grades of live stock, the preparation of live stock for a specific class, and finishing the live stock so that it is classified as prime or choice will do much to stabilize prices. Besides this, a study of the markets and a study of the

supply and demand in different localities will do much in aiding farmers to distribute their products and thus prevent radical fluctuations in prices. Coöperative marketing of live stock is becoming a common practice and is in many instances saving money for the farmers. Efficient marketing of live stock is of mutual interest to producer and consumer and the services now being rendered by the Government in gathering and impartially distributing market news regarding live stock are appreciated by all who know of its work.

LABORATORY EXERCISES AND HOME PROJECTS

1. From a study of your home paper learn the market classes of horses, beef cattle, and sheep, and the prices of each classification and grade.
2. If eggs weighing 26 oz. are worth 30 cents per dozen, what is a dozen worth which weighs 22 oz.? 20 oz.?
3. If there is a buyer of live stock in your community, have him explain market classes and grades of live stock, live stock markets, and why prices on live stock vary so much.
4. Bring to school a dozen eggs and judge them according to the score card found at the close of the chapter on poultry.

PART TWO

FARM MECHANICS AND FARM MANAGEMENT

CHAPTER XI

USE OF CONCRETE

Definitions. — Concrete is the product resulting from a suitable mixture of cement, sand, pebbles, and water, which has been permitted to harden under favorable conditions. Concrete is an artificially manufactured stone. A sidewalk made of cement, sand, pebbles, and water properly united is called a concrete sidewalk.

Cement is an adhesive substance used for uniting bodies to each other. In connection with our discussion it means a calcined mixture which will harden under water and which is used for making mortar. Mortar is a mixture of cement, sand, and water.

History of cement. — Cements of one kind or another have been used since prehistoric times. Natural cement in limited quantities was used in the United States for many years. From 1818 to 1830 only 300,000 barrels were used. The use of natural cement came to its climax in 1899 when 10,000,000 barrels were produced.

Artificial cement was invented in 1824 by Joseph Aspdin, an Englishman. He called his product "Portland Cement" because of its close resemblance to the limestone secured from the Portland Quarries on the English Channel. The manufacture of artificial Portland cement was introduced into the United States by David Saylor of Pennsylvania in 1875. At first the production and use of Portland cement were limited. This was due to the high cost of production.

In the years 1912, 1913, 1914, the amount of cement produced in the United States was 85,925,651 barrels, 89,541,348 barrels, and 87,257,552 barrels respectively. In 1914, Pennsylvania produced 26,570,151 barrels; and Indiana produced 9,595,923 barrels. Other states in order of the production of cement were: New York, Illinois, California, Missouri, Michigan, Iowa, New Jersey, Kansas, Texas, Washington, Ohio, and Utah. A sack of cement contains 94 pounds, and 4 sacks, or 376 pounds of cement, make a barrel. A sack of cement is counted the equivalent of one cubic foot.

Portland cement is used on farms in the construction of walks, foundations, silos, fence posts, troughs, driveways, and tiling. Railroads and the State and National Governments are extensive users of cement.

Some things to avoid in the making of concrete. — Defective and unsatisfactory concrete may be traced to one or more of the following causes:

1. Use of an improper amount of water in mixing, — generally too much water is used.
2. Use of dirty sand and gravel. Clay, loam, or other foreign matter will not permit proper cementation. It should not be expected that dirt or mud would make a good concrete.
3. Use of dirty water, or water containing injurious chemicals.
4. Use of poor aggregates; that is, sand and gravel not having the required physical properties. Soft soapstones, shale, and slate do not have the toughness to make good concrete.
5. Use of insufficient quantity of cement.
6. Insufficient mixing.
7. Permitting the concrete to dry out too quickly. This prevents the concrete from hardening and curing properly.

Essentials for success in making concrete durable. — If concrete is to be durable and permanent it must be properly

made. The materials, their proportion, mixing, and curing are all important in getting a good concrete.

1. The materials used must possess certain properties if a durable concrete is expected. Standard specifications require that 78 per cent of the cement shall pass a No. 200 sieve; that is, one having 200 meshes to the linear inch. Cement is manufactured at the present under such exacting conditions that practically all cement is of the best quality. Seldom is cement found that has not good binding qualities. The sand used in making cement should not be too fine. Coarse, sharp sand makes much better concrete. Great care should also be used in selecting the

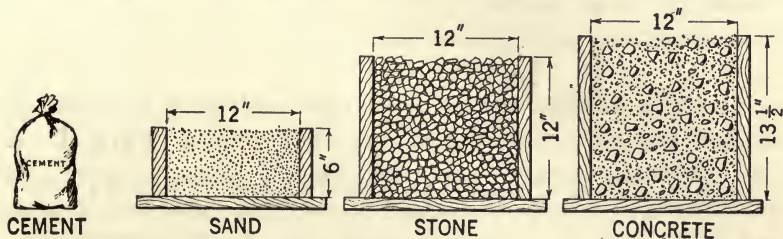


FIG. 90. — Amount of aggregates to use in making concrete.

stone or gravel. It should be hard and solid, and be free from clay or dirt, for such foreign material prevents cementation or binding. For thin walls use $\frac{1}{4}$ to 1 inch stone; and for thick walls or structures, stones measuring $\frac{1}{2}$ to $2\frac{1}{2}$ inches in diameter.

2. The proportion of the aggregates used in making concrete varies to a considerable extent. That mixture in which all spaces, called voids, between the gravel and sand are filled with cement is the ideal mixture. Figure 90 illustrates the amount of each aggregate to be used in making concrete.

In making various things the following proportions of aggregates may be used:

PROPORTION OF AGGREGATES IN MAKING CONCRETE THINGS

	CEMENT	SAND	GRAVEL
	Parts	Parts	Parts
For sidewalks, gutters, etc. . . .	1	$2\frac{1}{2}$	5
For silos, tanks, cisterns, fence posts, etc.	1	$2\frac{1}{2}$	4
For finishing inside walls of water tanks, silos, etc.	1	$1\frac{1}{2}$	0
Concrete blocks and tiles, etc. . .	1	3	0

A 1 : 2 : 4 mixture means a mixture containing one part of cement, two parts of sand, and four parts of stone or gravel. A sack of cement occupies one cubic foot of space. If a 1 : 2 : 4 mixture is desired, use one sack of cement, two cubic feet of sand, and four cubic feet of stone or gravel. Such a mixture requires 5 to 6 gallons of water. It is, of course, evident that the aggregates must be well mixed in order to make a durable concrete.

Amount of aggregates to use to make a cubic yard of concrete. — To find the amount of aggregates to use in concrete construction, first find the cubical content of the walk, wall, or thing which is to be constructed. Determine the dimensions of the thing that is to be built in terms of cubic yards. Then use the following table to determine the amount of aggregates to use in its construction. But proper proportion of the materials is no more important than the proper preparation of them by thorough mixing. One cubic yard of rammed concrete will require the following :

AGGREGATES TO MAKE CUBIC YARD OF RAMMED CONCRETE, USING ONE INCH STONE AND UNDER

MIXTURE	BBL. OF CEMENT	CUBIC YARDS OF SAND	CUBIC YARDS OF STONE
1 : 1½ : 3	1.85	0.42	0.84
1 : 2 : 4	1.46	0.44	0.89
1 : 2½ : 4	1.35	0.52	0.82
1 : 2½ : 4½	1.27	0.48	0.87
1 : 2 : 5	1.27	0.39	0.97
1 : 2½ : 5	1.19	0.46	0.91
1 : 3 : 5	1.11	0.51	0.85
1 : 3½ : 5½	1.00	0.53	0.84
1 : 3 : 6	1.01	0.46	0.92
1 : 3½ : 6	0.95	0.50	0.87
1 : 3 : 7	0.91	0.42	0.97
1 : 3½ : 7	0.87	0.47	0.93
1 : 4 : 7	0.83	0.51	0.89
1 : 4 : 7½	0.80	0.49	0.91
1 : 4 : 8	0.77	0.47	0.93

Thus to make one cubic yard of a 1 : 2 : 4 mixture use 1.46 barrels of cement, or 6 sacks, 0.44 cubic yard of sand, and 0.89 cubic yard of stone, using one inch stone and under. A barrel of cement contains 3.8 cubic feet of cement, and a cubic foot of cement weighs 94 pounds.

Mixing the concrete. — After the dry ingredients are measured out according to definite proportions they are poured together on a platform and mixed until the entire mass has one uniform color. Thorough mixing can hardly be overemphasized.

After the dry ingredients are thoroughly mixed, water is added. For thin walls and thin sections more water is added to the concrete, and it is called a very wet mixture. For building foundations and floors a medium mixture is used. The concrete is just wet enough to make a jellylike paste. Dry mixtures are

used for walls where the concrete is desired to set as quickly as possible. The difference between the mixtures is that the dry mixtures will set more quickly and are more difficult to handle. When the concrete sets, the results will be identical.

The tools shown in Figure 92 are used in mixing concrete.

Forms for concrete. — The design, arrangement, and construction of the forms are often as important as the placing of the concrete. Contrary to a prevalent opinion, dry wood is not well



FIG. 91. — Thorough mixing of the aggregates is essential in making good concrete.

suited for forms, because it absorbs too much moisture from the concrete. Green oak, pine, spruce, or fir is best suited for forms, for the expansion and shrinkage of these woods is uniform, and they do not absorb very much moisture. Forms must be made strong enough so that they will not bulge out; but the use of nails in forms should be reduced to a minimum, for in pulling nails the concrete is often cracked. Forms are sometimes removed too soon. Where there is little pressure against the forms, they may be removed in 36 to 48 hours. Where wet mixtures are used forms should remain in place 50 to 60 hours.



FIG. 92. — Tools used in mixing concrete.

Placing the concrete. — No time should elapse between the mixing and the placing. An important thing to remember is that the materials should not separate in placing. After the

concrete is put into the form it should be tamped lightly until the water shows on top, and no stones are left uncovered by mortar. The sides of the concrete should be spaded, for this

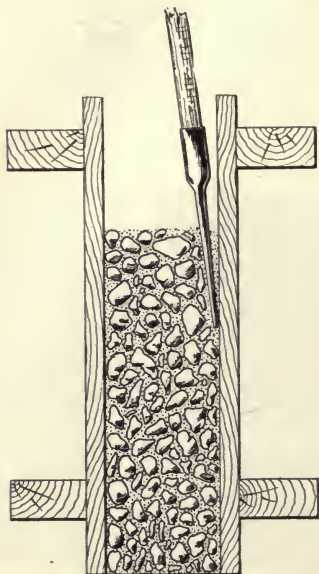


FIG. 93. — "Spading" of concrete in wall forms forces the coarse aggregates back from the face and produces a smooth surface on the finished wall.

will press the coarser materials toward the inner part of the wall and leave the face of the wall smooth. This method of spading the concrete wall is shown in the figure.

Reënforcement of concrete.—Concrete is strong and offers much resistance under compression. But its tensile strength is very small. Since iron and steel are strong in tensile strength they are much used to reënforce concrete. A concrete bar will carry very little weight, but when it is reënforced with rods, it will carry a fairly large load.

The kind of material to use in reënforcing concrete consists of steel bars and wire. Round bars three sixteenths or one fourth inch in diameter are used most on the farm.

The ordinary wire fencing is well suited for reënforcing. The stock of rods carried by the blacksmith are too soft and do not have the tensile strength necessary for reënforcement purposes. Reënforcing material may now be had from companies who make it their specialty to manufacture it. Ungalvanized steel is as good as galvanized, for when steel is incased in concrete it will not rust.

The strength that reënforced concrete will have depends upon a number of things. The amount of steel used ordinarily is in

total area of cross section ranging from 1 to $1\frac{1}{2}$ per cent of the total cross section area of the concrete beam or slab in which it is incased.

Reënforcing materials are used in making fence posts, bridges, foundations, walls, columns, silos, beams, and other kinds of construction that have to carry tension weight.

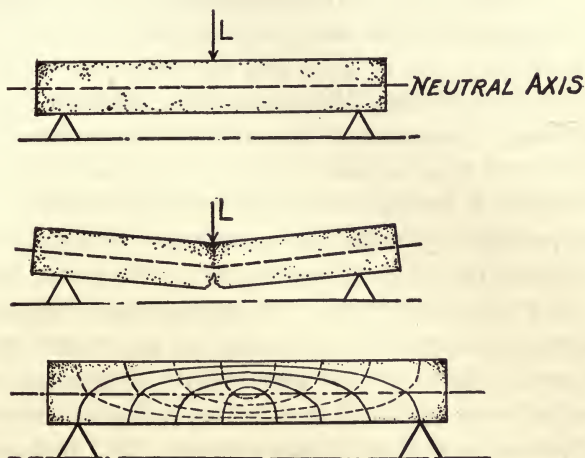


FIG. 94. — The upper two bars show how a single beam breaks. The lower one shows where the reënforcement may be placed.

Waterproofing. — Concrete may be made water-tight. This may be done by the use of a water-tight mixture made of one part of cement, two of sand, and three of gravel. Lean mixtures of concrete will not hold water, because the pore space is too open. Open, porous concrete will absorb water just like a sponge. Therefore, the mixture must be made so that there are no voids or openings in the concrete. Felt, tar paper, and asphalt-coated paper may be used in some instances to make the concrete waterproof. But in the construction of troughs, tanks, and cisterns it is recommended that the mixture of the mortar be so made

that all voids are closed. A final coating of cement alone will help in making the article waterproof.

Oil is sometimes mixed with the concrete to make it waterproof. The weight of oil used should not exceed 5 per cent of the weight of the cement used. A bag of cement weighs 94 pounds. Therefore, for each bag of cement use 4.7 pounds or about $2\frac{1}{2}$ quarts of oil. In mixing use the following method: First mix thoroughly the sand and cement until they appear to be of a uniform color. Then add the water and mix with the cement. Finally add the oil and continue the mixing for double the usual time. Basement floors, and cellar walls may be easily waterproofed by this method. Heavy, crude oil, containing no fatty or vegetable matter, is recommended for this use.

Curing process. — Curing the concrete is an important process in making the concrete satisfactory. Attention should be given to the following points: 1. During warm weather concrete should be prevented from getting too warm and dry. Concrete hardens within a few hours, but its greatest strength continues to develop for 28 days. Hardening of concrete is a chemical process and not a drying process. In a test made in a laboratory, concrete allowed to air-dry for 120 days had a compression strength of 1800 pounds per square inch; but concrete kept in a moist sand for the same length of time had a compression strength of 4500 pounds per square inch. Therefore, protect the concrete from drying out rapidly by watering or covering with a canvas or sand, and from the sun by covering with straw for at least ten days. Generally speaking the protective measures above described are not needed when the temperature is near 50° Fahrenheit, for the concrete does not ordinarily dry out so rapidly under such conditions nor does it harden so readily.

2. Concrete may be laid in cold weather provided the sand, gravel, and water used are heated to a temperature of at least

170° Fahrenheit. The cement need not be heated for it makes up only a small part of the bulk. Warmth given the concrete may be retained, provided the concrete is protected as soon as it is placed. Walks and underground walls may be protected from the cold by use of hay or straw. Interior walls may be kept warm with a stove. But the heat in the room should not run very high, for rapid drying of the concrete reduces its quality. Concrete work should not be done when the temperature is below 35° Fahrenheit.

Cement storage. — All standard Portland cement, when it leaves the mine, is of high quality because the methods of manufacture are so correct that quality can be perfectly controlled. But cement has a great affinity for water, and if exposed to moisture will absorb it readily; whereupon chemical action takes place. For this reason, care should be exercised to keep it perfectly dry until it enters the mass where it is to be used. Never store cement on the ground or in places where it will absorb moisture, — as only a little moisture will cause it to partially, if not completely, harden and destroy its value as bonding material.

Summary. — The use of cement on farms is constantly increasing, and therefore it is important to learn something about its use. Poor results with concrete are usually due to poor mixing, improper proportioning, dirty material, or the use of too little cement. The tensile strength of concrete is small, and therefore it must be reënforced in a great many instances. Proper proportioning, mixing, placing, and curing are important in the production of a good quality, satisfactory concrete.

LABORATORY EXERCISES AND HOME PROJECTS

1. Make a survey of your school district, listing the concrete found, such as silos, posts, troughs, cistern tops, walks, porches, foundations, floors, etc. State dimensions of each and the approximate cost.

2. Get some cement, sand, and gravel, and make little concrete beams in a form with different proportions of the aggregates, such as 1 : 2 : 4; 1 : $2\frac{1}{2}$: 5; 1 : 3; etc. Make the beams 1 inch $\times$ 1 inch $\times$ 8 inches. After curing for some time, — say 24, 48, 96 hours, and some for 28 days, — place ends of beams on rods or blocks of wood, tie a balance to the beam, and then weigh it down by piling on material until the beam breaks. Record results.

3. Make reënforced beams with concrete of the same size as those suggested in Exercise 2. Use baling wire or a wire which is a little heavier. Try the experiment by placing wire in different ways in the concrete. In some beams place the wire straight; in others place the wire curved upward, and in others downward. Test these beams as in the preceding exercise.

4. Determine the cost of making a concrete walk 3 feet wide, 50 feet long, and 5 inches thick. Include every item of cost of production.

CHAPTER XII

CONCRETE STRUCTURES

Advantages and disadvantages of concrete structures. — The use of concrete has several advantages: (1) Concrete structures are fairly permanent. Rust, worms, and fire do not destroy concrete, and the weather does not affect or change concrete to any great extent. (2) The initial cost of concrete is not much greater, and in some instances is even less, than the initial cost of other building materials. On many farms sand and gravel are found which, if cleaned, will make good building material. (3) Concrete costs less for repairs than do other materials used in construction. Concrete does not warp, dry out, or decay, and concrete does not need to be painted. (4) Concrete structures are attractive in appearance. Various colors and shades may be used in beautifying concrete. (5) Concrete structures are rat and mouse proof. This is very desirable.

The use of concrete has a few disadvantages: (1) Buildings made of concrete are not easily moved, and it is desirable in many instances that small buildings, such as poultry houses and hog houses, be movable. (2) When the ordinary bank-run sand or gravel is used in concrete constructions, unsatisfactory results may be expected. This is not really a disadvantage of the use of concrete, but a fault of construction. (3) The final cost of concrete will often be pretty large, if an inexperienced, unskilled person does the work. Unless all operations with concrete are properly and well done, unsatisfactory results are sure to follow. This probably is an advantage for concrete for it means careful

work, which results in the highest efficiency. With these statements we will proceed to discuss some typical concrete structures. It is believed that from the following suggestions other ordinary structures on the farm may be satisfactorily built from concrete.

Fence posts. — Ekblaw, in his book entitled "Farm Concrete," says: "It is estimated that there are 5,000,000,000 fence posts in the United States, and that the average life of

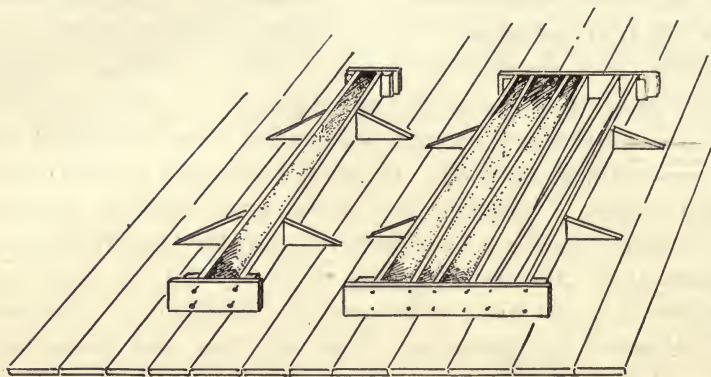


FIG. 95. — Homemade post molds.

wooden fence posts is about five years." Posts made from cedar, osage orange, locust, and mulberry, of course, are more durable. Concrete posts have the advantage of being reasonably durable, and permanency and durability are constantly receiving more attention. The rubbish in which insects harbor along fence lines may be burned where concrete posts are used without injury to the posts. Concrete posts, when once set, do not need repair and straightening up as often as do wooden posts.

In making concrete posts especial attention should be given to (1) forms, (2) proportions, (3) reënforcement, and (4) curing.

1. Forms may be made from either wood or iron. The dimen-

sions of the form must be correct, and the form itself strong enough so that it does not bulge. The preceding figure shows one type of a post mold or form.

The ordinary fence post is 7 feet long, at least 5 inches square at the bottom, and 3 inches square at the top. Of course posts vary a great deal in shape and cross section. Posts 5 by 5 inches at the bottom and 3 by 5 inches at the top are of good shape. Such a post should be placed perpendicular to the fence, for this gives additional strength when the load comes from either side. The cross section of different shaped posts and the placing of reënforcement are shown in the following illustration.

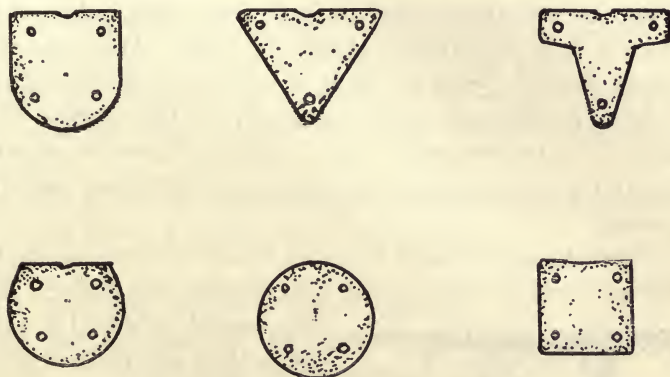


FIG. 96. — Cross sections of different shapes of posts.

2. The proportion of aggregates used in making concrete posts is that of a 1 : 2 : 3 mixture. Where small posts are made the particles used should not be more than $\frac{1}{2}$ inch in diameter. In the construction of larger posts, larger aggregates may be used. Thorough mixing of the aggregates is, of course, essential in making good concrete.

3. Reënforcing is fundamental in making fence posts. Concrete is strong under pressure, but fence posts must have bend-

ing strength. For this reason they must be reënforced. Some have thought that a gas pipe through the middle of a concrete post was the best reënforcement, but laboratory tests show that the reënforcement should be placed close to the four corners or edges of the post. After the concrete has been laid in the form to the depth of a half inch the reënforcing material should be laid in the concrete. When the form has been filled to within a half inch of the top, reënforcing material should again be used.

No. 5 rods, which are one fifth of an inch in diameter, make about the best reënforcement for concrete posts. In large posts and in end posts carrying a heavy strain, wire or rods one fourth inch in diameter should be used. The ends of re-enforcing rods or wires are bent in order to prevent slipping. Since fence posts break quite frequently at the surface of the ground, it is recommended that additional reënforcement be placed at the base of posts, extending two feet below and above the ground.

4. Concrete posts should be cured about 60 hours before they are moved, and sprinkled several times during this period. They



FIG. 97. — Attachment of fencing to post.

then should be stored in a place where they are protected from sun, wind, and frost.

Attachments to the posts are best made by a wire extending around the post as shown in Figure 97.

Concrete foundations. — A concrete foundation should have carrying capacity and should be water-tight. Some soils have a low bearing power, while others resist a heavy load. Ekblaw quotes Mr. George B. Frances in giving the following weights that different materials will carry under compression.

COMPRESSION LOADS DIFFERENT SUBSTANCES WILL CARRY PER SQUARE FOOT

MATERIAL	TONS PER SQUARE FOOT THESE SUBSTANCES WILL CARRY
Solid rock . . .	36
Hardpan . . .	8
Gravel	5
Sand	4
Dry clay . . .	3
Wet clay . . .	2
Loam	1

Thus it will be seen that solid rock will carry 36 tons of weight per square foot, and that loam will carry only one ton.

In making the form for a concrete wall the soil is often used. This may be done provided the soil is compact, and does not give way.

In laying out the work, squaring of corners may be done by the use of the 3, 4, 5 rule, or by use of the square.

The wall may be made water-tight by using the aggregates in their proper proportion. A mixture in the proportion of 1 : 2 : 3 will afford the desired resistance to the passage of water. All walls should be put deep enough so that they are below the frost line. Foundation walls for barns should be at least 2 feet deep and 1 foot wide; while foundation walls for residences may be 18 inches deep and 12 inches wide.

Since concrete has little strength to carry a load when in the form of a beam, it is evident that it must be well reënforced when



FIG. 98. — Method of squaring corners. Measure 3 feet along one side, 4 feet along the other, make the hypotenuse 5 feet, and the corner will be square.

it is so used. But in case the pressure is not very great, unreinforced concrete may be used. This is true in the case of small basement windows. Where the soil is not capable of carrying the load, its carrying ability may be assisted by reënforcing the foundation walls. Rods placed near the lower edges of the wall will give the greatest reënforcement. When large structures are built, a competent builder should supervise the work.

Floors, pavements, and sidewalks.— Floors, pavements, sidewalks, and especially roads should be built on a firm, unyielding base; they should be built so that water will not soak into the concrete and stay there, because if it does the concrete is sure to be broken by freezing. The foundations upon which concrete is laid should be firm, smooth, and unyielding at every point. In fact, in building roads it is well to make the roadbed a year before the concrete is put on it. This gives the fills time to settle, and thus a good substantial base is prepared for the concrete. For floors and walks a layer of chat, cinders, or coarse gravel is often placed on the ground as a base for the cement. This is a good practice, for 2 or 3 inches of this material will prevent the soil water from coming up by capillarity into the concrete floor. Good drainage is essential in road and walk construction. Therefore, they should be slightly rounded. Some information regarding the construction of floors, sidewalks, and roads is given in the following table.

PROPORTION OF AGGREGATES TO USE

	THICKNESS	PROPORTION OF AGGREGATES	MAXIMUM SIZE OF AGGREGATES
	Inches		Inches
Floors . .	4-6	1 : 2½ : 4	1½
Sidewalks .	4-5	1 : 2 : 4	1½
Roads . .	6-7	1 : 2 : 4	1½

Walks and floors should be finished and smoothed at the top by the use of a wood float. A metal trowel should be used sparingly, if at all, because its use brings a film of cement to the surface which lacks wearing ability and which often develops hair cracks.

Concrete may be used for making feeding floors for cattle, hogs, sheep, and poultry. Hogs that are fed either in a very dusty or a very muddy pen show little gain.



FIG. 99. — Concrete feeding floor for hogs saves feed, may be easily cleaned, and prevents sickness among hogs.

Concrete silos. — The claim is sometimes made that certain building materials improve the flavor, feeding value, and keeping qualities of silage. This is entirely false, for it is well known that the essentials of a good silo are :

1. It must be air-tight.
2. It must be water-tight.
3. It should be smooth inside.

The silage absorbs nothing or very little from the walls of the silo, and, therefore, the silo itself imparts no flavor to the silage. Foods and feeds are preserved by canning, drying, salting, pickling, cold storage, and ensiling. Bacteria that cause decay need heat, moisture, air, and food. In each method of food preservation one or more of these factors of bacterial growth must be absent. The silo excludes the air; otherwise, the silage spoils.

The materials used in silo construction are wood, concrete blocks, brick, monolithic concrete, glazed tile, and sheet metal. The pit silo dug in the ground is used in the West. No material in silo construction has superiority over any other in improving the quality of the silage. Concrete silos are fireproof, they are durable when set on a good foundation and properly constructed, and the silage does not in any way affect the concrete.

Corn will yield silage at the following rates:

30 bushels corn		6 tons
45 bushels corn		9 tons
60 bushels corn		12 tons

To estimate the proper dimensions for a silo the following table may be used.

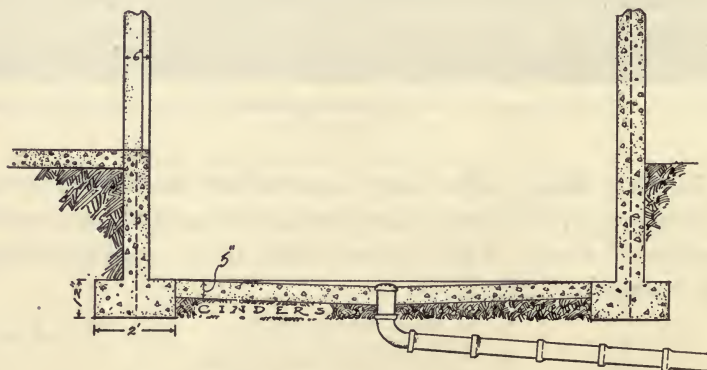


FIG. 100. — Construction of silo floor and foundation.

SILAGE-FEEDING TABLE FOR 182 DAYS

NUMBER OF COWS	ESTIMATED CAPACITY	DIAMETER	HEIGHT
	Tons	Feet	Feet
7	26	10	20
14	51	10	30
21	73	12	32
30	109	14	34
40	143	16	34
50	181	18	34

Concrete silos may be put 5 feet into the ground, and the foundation should be built very secure. A drain may be put underneath as illustrated in Figure 100.

Forms for building concrete silos are usually about 3 feet tall and one section of about 3 feet may be added to the silo daily until it is complete.

The sand and gravel used in building a concrete silo should be absolutely clean, otherwise the work will not be durable and satisfactory. The amount of aggregates needed in putting on a wall one foot high follows:

AMOUNT OF MATERIAL NECESSARY FOR A SILO WALL, 1 FOOT IN HEIGHT
AND 6 INCHES THICK, MADE OF A 1 : 2 : 4 MIXTURE

DIAMETER	BARRELS OF CEMENT	SAND	GRAVEL
Feet		Cubic Yards	Cubic Yards
8	.78	.23	.46
10	.96	.30	.60
12	1.14	.36	.72
14	1.32	.42	.84
16	1.50	.47	.94
18	1.68	.53	1.06

Reënforcement material for silos is of two kinds: the triangular mesh reënforcing material made especially for the purpose, and rods. The triangular mesh wire comes in 14-inch and



FIG. 101. — Building a silo and a metal form for monolithic silo construction.

38-inch widths. The latter gives 2 inches for overlapping into the concrete put on the next day.

Concrete roofs are usually put on concrete silos, and spaces are left for doors. Chutes are often built of concrete and made an integral part of the silo, although wood chutes are sometimes built.

Hollow tile silos are becoming more common, especially in the Northern States, because the hollow air space is a protection against heat or cold.

Other things which may be constructed from concrete. — Porches, porch piers, gutters, hog wallows, dipping vats, manure

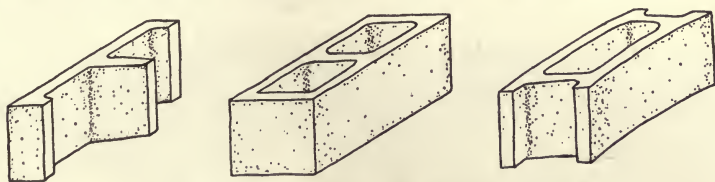


FIG. 102. — Types of concrete blocks.

pits, flower boxes, cisterns, mangers, hotbeds, retaining walls, milk houses, garages, corn cribs, granaries, and bases for machinery may all be made of concrete.

Summary. — Wood and steel as building material are being replaced by concrete. Concrete has many advantages and some disadvantages. In order that satisfactory results may be secured with concrete the materials used must be of the best quality, and the utmost care must be used in the method of construction.

LABORATORY EXERCISES AND HOME PROJECTS

1. Estimate the materials needed and determine the cost of constructing a concrete walk three feet wide and extending from your house to the barn or to some other near-by building.
2. Estimate the cost of constructing a concrete wheat bin which will hold 300 bushels of wheat.
3. Often pits are found in concrete roads. What is the cause of these pits? Cracks are often found in concrete walls. What is the cause? Sometimes concrete crumbles easily and in the case of roads the concrete wears away easily. What causes the concrete to crumble?

CHAPTER XIII

ROAD CONSTRUCTION

Benefits of good roads. — Well-built roads benefit the farmer in several ways: (1) They allow him to market his products, such as wheat, oats, corn, and hay; and his animals or animal products, such as milk, butter, and eggs any day in the year. A large part of the farmer's products are seasonal and are therefore dumped upon the market during a short period. This causes the prices to go very low. If the farmer could hold his product and market it during the season when the inflow of the supply is at a low ebb, he would then have a chance to get the highest market price. (2) Good roads save time. His products may be stored in summer and marketed in winter. This conserves his time in summer which is the period of production. Again, the time of travel is shortened by good roads. On muddy roads it requires as much as three hours to haul a small load 8 miles; whereas if the roadbed is firm twice as large a load may be hauled in a shorter time. (3) Good roads lessen the wear on the vehicle and upon the motive power. A wagon or an auto truck will last almost twice as long on a good road as on a bad road; and the repairs on vehicles will be less where they are used on good roads. (4) Good roads make for better attendance of rural people at church and school. Good roads improve social conditions.

In the last 5 or 10 years roads have been much improved; and it is safe to presume that in the next decade or two, greater im-

provements will be made than have been made in all preceding road history combined. It has been found that it is economy to build good roads. The rural mail delivery, the extension of the parcel post system, the use of automobiles and auto trucks, the consolidated school, and the federated church have all aided in the improvement of roads.



FIG. 103. — The benefits of good roads are good horses, good homes, and better communities. The above is the Rock Levee Road just south of Cape Girardeau, Missouri, bordering the Mississippi River.

Farmers' Bulletin No. 505 states that roads have two benefits, — an economic and a social benefit. The economic benefits are: (1) reduction in cost of hauling; (2) aid in an equal distribution of agricultural products; that is, products may be hauled

any day in the year; (3) increased value of farm land; and (4) increased tourist travel. The social benefits of good roads according to this bulletin are: (1) improved schools and school attendance; (2) improved rural delivery; (3) improved social conditions; and (4) development of a community spirit.

Essentials of good roads. — The essentials of good roads are: (1) proper location; (2) easy grades; and (3) a smooth, hard, durable surface.

1. Roads should first of all be properly located. Every state should have a state system of highways to which communities may build. Large centers of population should be connected with good roads. Then county seats and other towns should be the basis for the location of roads. The topography of the land may in some instances determine the location of roads, and in other instances section lines. In the newer states roads are located along section lines. In the older states roads are generally winding roads because they were laid out haphazardly before section lines were located.

2. Easy grades are very helpful in making roads satisfactory and comfortable. Grades should not exceed 3 per cent, or a 3-foot rise in 100 feet of road. Roads which are not used much may have a 6-foot rise in 100 feet. But in the long run it pays to make the cuts deep and the fills high, for it conserves energy and time and makes the road much more satisfactory.

3. A smooth, hard, durable wearing surface is essential to a good road. Concrete makes a smooth surface, and a surface which is durable when it is properly constructed.

Kinds of roads. — The kinds of roads are: (1) dirt roads, (2) gravel roads, (3) macadam roads, and (4) concrete roads.

1. A road made of clay, when well rounded at the top and kept smooth by rolling and dragging, makes a very serviceable road. Dirt roads constitute, according to the Office of Public

Road and Rural Engineering, 89.5 per cent of all roads in the United States, or 2,200,000 miles. All other roads combined constitute about 300,000 miles. It may be seen that dirt roads will for many years to come be the chief roads in the United States. It is for this reason that the dirt road should be well considered. Dirt roads should be at least 18 feet wide, and where there is much traffic they should be 30 feet wide. Clay, sand, and gravel are used in the building of dirt roads. Clay makes a fairly good road, and a road made of two thirds clay and

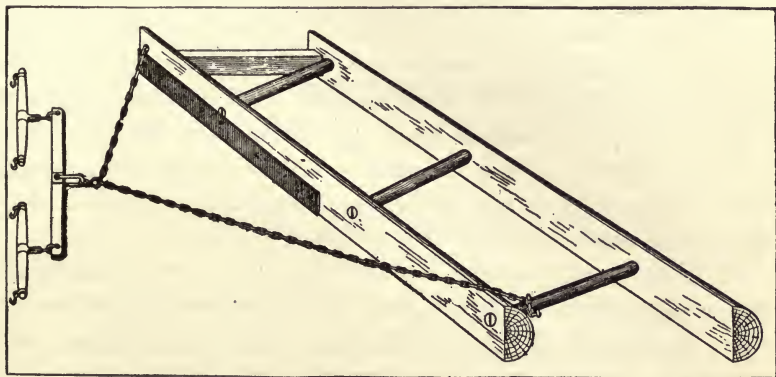


FIG. 104. — View of a split-log drag. Its use has done more after roads were properly constructed to make good roads than all other things combined.

one third sand usually makes a fine road. Drainage is very important in road construction. For this reason the crown should slope to the sides at the rate of 1 inch to the foot. Side ditches should be so made that surface water is rapidly carried away.

The split-log drag used on earth roads is indispensable. The road drag has several advantages: (a) It maintains a smooth surface, which reduces the draft, and causes the road to drain itself naturally. (b) It reduces the mud and ruts in the road,

causes the road to dry out readily, and, hence, makes the road much more serviceable. (c) It packs the roadbed, which tends to keep down the dust. (d) It eliminates the grass and weeds of the portion of the road dragged.

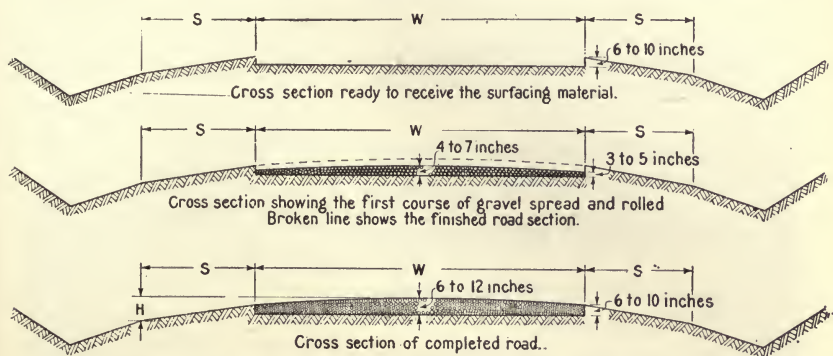
Roads should be dragged at the right time; that is, when the soil is moist but not sticky. It is difficult to say just how often roads need dragging, for this depends upon a good many conditions. This should be left to the advice and counsel of road men.

Oiling earth roads helps to keep down the dust, to drain the road, and to make it more durable. Crude oil or the residuum secured in refining oil is fine road-oiling material. It requires almost one gallon of the oil per square yard of road. This, of course, depends somewhat upon the character of the soil found in the roadbed. Oiling of earth roads is practicable around towns, but probably not in the rural districts, because it costs more than rural conditions will justify.

2. Gravel roads constitute about $4\frac{1}{2}$ per cent or 116,000 miles of the roads of the United States. There are two distinct operations in making the graveled road. These are grading and graveling. Grades should not exceed 3 or 4 feet per 100 feet; and the crown of the road should range from $\frac{1}{2}$ to 1 inch fall per foot. Figure 105 illustrates how the road should be prepared and graveled.

The depth of the gravel at the crown should be 8 to 10 inches where there is heavy traffic, and 6 to 8 inches where the traffic is light. The gravel is usually put down in two or three layers. After each layer is put down it should be harrowed well, and then compacted with an 8-ton roller. The kind of gravel used affects materially the durability of the road. Hard pebbles composed of quartz or chert make the best road material. Soft stones and stones composed of sand are not good road-building material.

A small amount of clay, up to 10 per cent of the entire mass, helps in binding the road material together. The first layer of gravel may contain larger pebbles but the covering layer should not contain pebbles larger than $\frac{1}{4}$ to $\frac{1}{2}$ inch; for larger pebbles cause the road to wear unevenly, and the larger pebbles will be constantly sticking above the level of the road. Many localities have excellent gravel beds which furnish the best of material



TYPICAL CROSS SECTIONS SHOWING METHOD OF CONSTRUCTING A GRAVEL ROAD

"W" should be at least 10 feet for single track roadway and "S" generally not less than 5 feet, for double track, "W" should be not less than 14 feet and "S" not less than 3 feet.

"H", crown, varies from $\frac{1}{2}$ inch per foot for level grade, to 1 inch per foot for a grade of 5%.

FIG. 105.

for graveling roads. This reduces the cost of road construction; for ordinarily it has been found that it is not expedient to transport gravel more than 100 miles for road building.

The gravel used in building roads should be thoroughly cemented or tied together by a binding material such as clay, lime, or iron oxide. These substances are often naturally found in the gravel used. This binding material ties or binds the gravel together so that the road presents a combined resistance to the disturbing action of the traffic.

3. Macadam roads were first built by John L. Macadam, and hence their name. Macadam roads are built from artificially broken stones, and are bonded, cemented, or tied together with

rock dust. Such a road might properly be called a broken-stone road.

Macadam roads are usually 12 to 16 feet wide, have a crown which drains well, and the macadam is generally 6 inches deep at the center, and 4 or 5 inches deep at the sides. In constructing the macadam road, the subgrade is first made and then a course of stones is put on, which is thoroughly packed with a heavy roller. The second course of stones is then put on and rolled until

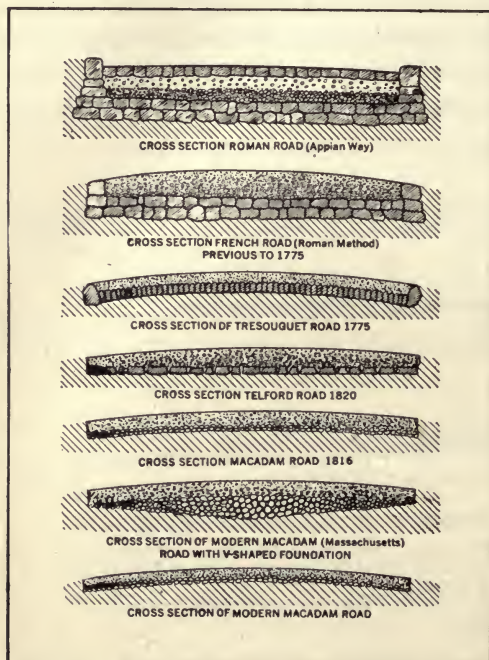


FIG. 106. — Cross sections of different kinds of roads.

the surface is smooth and even in every direction. Before the roller is used, sand or rock screenings are put on the road, and this material should close all voids. This protects the road from water, and makes a better traffic surface.

4. Roads made of concrete are becoming more common, and they seem to be growing in popularity. The principal advantages of concrete roads are: (1) They are fairly durable and the main-

tenance cost is very low. (2) They are smooth and offer little resistance to traffic. An average horse can pull one ton on a good level clay road; $1\frac{2}{3}$ tons on a good gravel road; $2\frac{3}{4}$ tons on a good level macadam road, and 5 tons on a good concrete road. (3) They are practically free from dust, and may be easily cleaned. (4) They present a pleasing appearance. (5) They reduce the cost of hauling. (6) They can be used every day of the year.



FIG. 107. — Hauling cotton on a concrete road in Madison County, Tennessee. Notice the large loads that are being hauled.

The *subgrade* should be well prepared. The principal considerations in preparing the subgrade are: (a) adequate drainage, (b) firmness, and (c) gentle grades.

a. Good drainage is absolutely essential to a good roadbed, for if the subgrade is not properly drained, water will get into concrete, and during winter it will likely be broken by freezes.

b. Firmness is a second requirement of a roadbed, and

this may be secured by properly draining and compacting the bed with a heavy roller. *c.* The roadbed should have gentle grades. It is well known that a horse can draw only one half as much on a five per cent grade as he can draw on the level; and on a ten per cent grade he can pull only one fourth as much. The steepest hill fixes the load which can be drawn over a road and, hence, it is much better to make the grades as gentle as possible.

In building a concrete road a 1 : 2 : 4 mixture is recommended. The proper depth of the concrete is about 7 inches in the center and 4 or 5 inches at the sides. Aggregates which are greater than $1\frac{1}{2}$ inches in size should not be used. When the concrete is poured on the roadbed, it may be smoothed and leveled with a long board drag. The coarse stones may be lowered slightly with a drag before the concrete sets, and the surface is best smoothed with a board drag. The utmost care should be taken that only clean aggregates are used, for if clay and dirt are incorporated in the road, it will be only a short time until small openings may be seen in the surface of the road. These small pits soon enlarge, and winter weather may cause the concrete to be cracked open by freezes.

Transverse joints are placed at regular intervals of 25 to 50 feet in concrete roads. These joints, made of board or bituminous felt board, protect the concrete against expansion and contraction and prevent cracks from spreading. A one-half inch joint placed at 25-foot intervals is sufficient to protect the concrete road.

What otherwise would be a good job of concreting is often spoiled by improper curing. Concrete should not be exposed to the hot sun, or be permitted to be dried out quickly by the wind. It may be protected against both sun and wind by covering it with a thin layer of straw, canvas, or soil. Concrete sets

in 24 hours, but it should be left to cure for three weeks, or better still for 4 weeks if the toughest, firmest, and best concrete is to be obtained. Concrete roads may be constructed when the temperature is down to 35° Fahrenheit, if the suggestions of the previous chapter are followed.

Roads should be well marked. — For illustration a State highway passing through the state of Illinois from Chicago to St. Louis might be marked by the number 1. Posts along this highway might be belted with white paint, and a black Arabic 1 be conspicuously painted in this white belt, or the black numeral might be placed in a white triangle as shown in Figure 108.



FIG. 108. — Roads may be marked with Arabic numerals.

The posts along the road leading from Chicago to Hannibal might be marked with an Arabic 2. In fact, the Federal Government should first mark and label the National highways; that is, highways extending throughout the land by some simple symbols, — numbers are preferable, — and then each state should mark its own roads in conformity with the marks used by the Government.

Summary. — The benefits of good roads from an economic and social standpoint can hardly be estimated. Better schools, churches, and communities are inevitably the result of good roads; and economically the farmer and the consumer are both benefited, because the farmer can distribute his products more evenly throughout the year, and hence the consumers' demand is more nearly supplied. Dirt roads constitute the major part of our roads and, therefore, it is important to know how to construct and maintain the dirt road. Grading, draining, and dragging are essential to a good dirt road. Where there is more traffic, gravel and macadam roads are built; and at the present time

many states are planning and building a system of State highways made of cement, sand, and gravel all bonded together into concrete. This makes a durable road, one which reduces the draft to a minimum, and saves time and wear. Good roads are a mark of civilization, but poor roads are a mark of the lack of progress. All money spent on road building should be economically expended and ordinarily under the advice of men who are experts in road building.

LABORATORY EXERCISES AND HOME PROJECTS

1. By way of a survey estimate the mileage of dirt, gravel, and concrete roads in your school district. Also find out if possible the cost of mileage construction.

2. If possible construct a road drag, and drag a half mile or more of road near the school. Compare from time to time its condition with other stretches of similar road which is not dragged.

3. Debate: *Resolved*, That it is more advantageous for your county or district to have dirt and gravel roads than to construct in their place concrete roads.

4. Gather as much information as possible on the laws governing and the methods used in building and maintaining the roads in your county and state.

5. Discuss fully the relation of the roads of your locality to the distribution and marketing of farm products, first, as to cost of transportation; second, as to amount of energy required to haul a load; third, as to wear and tear upon vehicle used; and fourth, as to time required on the road.

CHAPTER XIV

ROPE WORK

Importance of knot tying. — Every person ties some knots every day. How to tie a shoe string so that it will stay tied and look well is important. How to tie a horse or a cow so that the knot will not slip and strangle the animal tied is valuable information. Sometimes the hay rope breaks just when most needed, and a knowledge of how to splice it saves time and may save a good part of the crop. The use of cord, twine, rope, fishline, and steel cables finds a broad and general application in the daily life of our people. In every line of work a knowledge of the practical application of the different knots, hitches, and splices is very valuable. The laboratory work in rope tying is both interesting and practical, and can hardly be overemphasized.

Rope materials. — The most common materials used in making rope are manila, sisal, hemp, cotton, and wire. Manila fiber, which is named after the city of Manila, forms about 60 per cent of the exports of the Philippine Islands. It is procured from the leaf sheath of the banana-palm plant, which is native to the Philippines. This plant grows 8 to 20 feet tall and the leaf sheaths are 5 to 12 feet long. The manila fiber is cut and scraped from the leaf and leaf sheath and dried in the sun. The yield of this fiber ranges from 600 to 650 pounds per acre. The price of the fiber varies from 6 to 18 cents per pound in New York City. A pound will make 650 feet of twine of the best quality.

The sisal plant is native to Yucatan. This plant resembles

the century plant. The fiber ranges from 3 to 4 feet in length, and is very harsh and stiff. The price of sisal ranges from 5 to 12 cents per pound in New York City. Sisal fiber will make about 500 feet of twine per pound. It is whiter than manila fiber, and the two are often mixed in rope making.

Hemp is used to some extent in making cord and rope.

Cotton makes an excellent cord, for it is soft and white, but the cotton fiber on account of its shortness and lack of strength cannot be used in rope making where strength is required. But for store use and tying small halters cotton has no equal.

Wire is used in making ropes where great strength is required. Thus in dredging machinery, derricks, and lifting machinery wire cables are used. Wire ropes are used in the construction of suspension bridges.

Definition of terms. — A few of the more common terms used in connection with rope work will be explained.

A yarn is formed by twisting fibers together.

A thread is composed of two or more small yarns twisted together.

A strand is composed of two or more large yarns twisted together.

A cord is composed of several threads twisted together.

A rope is made up of several strands twisted together.

A hawser is a rope composed of three strands.

A cable is composed of three hawsers twisted together.

A hawser or a rope of three strands will bear a greater strain in comparison to its size than a rope made of any other number of strands.

Whipping rope. — Sometimes the end of a rope becomes unraveled. Then it needs to be re-laid before it can be whipped.

The process of twisting together strands of rope which have become untwisted is known as re-laying.

Figure 109 illustrates the method of re-laying a rope. Hold the rope firmly with the left hand, and twist each strand firmly with the right hand, re-lay, and pull it snugly into its place. If this work is done well the rope may be a little smaller yet a little stronger because it has been firmly twisted together.

Binding the end of a rope so that it will not unravel is known as whipping. A large knot on the end of a rope is not only in-

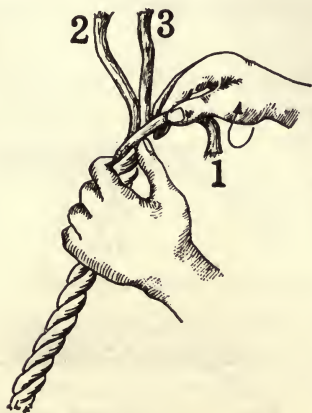


FIG. 109. — Re-laying the strands of a rope.



FIG. 110. — First step in whipping a rope.

convenient but it requires about 8 or 10 inches of rope. A knot will not pass through pulley blocks or a hole in a hitching post. In whipping a rope take a string about two feet long and lay one end on the rope, permitting the string to extend $2\frac{1}{2}$ or 3 inches beyond the end of the rope.

Then take the other end of the string and lay it on the rope with the end pointing down as shown in Figure 111.

Now with the right hand wind string tightly around the rope. Keep on wrapping the string around the rope until the string is almost used up. Then pull the end of the string until it is tight.

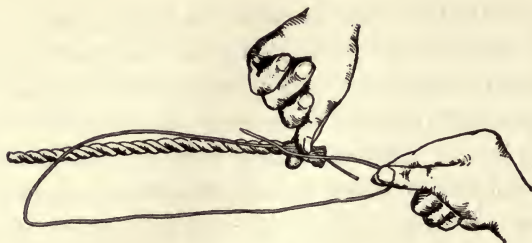


FIG. 111. — Second step in whipping a rope.

This completes the process of whipping. Do this several times because practice makes for perfection. Figure 112 shows the finished whipping.

Useful knots.—There are probably 50 or 60 different kinds of knots. Each of these knots is useful under certain conditions. The average farmer makes practical use of 8 or 10 different knots. The most useful knots will be discussed in this chapter.

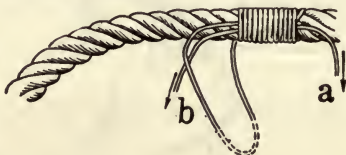


FIG. 112. — The finished whipping.

1. The *overhand knot* is the simplest of all knots. It is made by making a simple loop in the rope.



FIG. 113. — Overhand knot.

and through the overhand knot, it will in no way strangle the horse. In this respect it is a safe knot.

2. The *slip knot* is sometimes used in tying horses and other live stock. It should never be used in this manner.

The slip knot with a loop so that it is easily unfastened is used in tying animals to the manger. It is often called the *manger knot*.

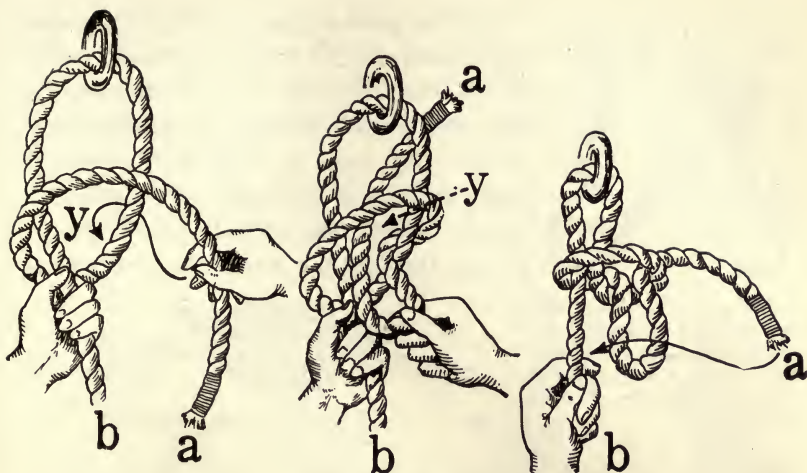


FIG. 114. — Slip knot.

3. The *square knot*, *reef knot*, or the *sailor's knot* is one of the commonest knots made. It is a dependable knot for it will not slip.

In tying the square knot put rope together as shown in Figure 115; then extend the part of the rope labeled *a* over the part

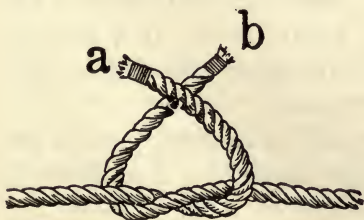


FIG. 115. — Square knot.



FIG. 116. — Square knot completed.

labeled *b* and pull the ends. The completed knot is shown in Figure 116.

The ends of the rope lie parallel in the square knot. Make the square knot until it is easily made. Shoes tied with the square knot appear well.



FIG. 117. — The shoe on the right foot is tied with a square knot. The other shoe is tied with a granny knot. Note the difference in appearance.



FIG. 118. — Granny knot.

in Figure 118 and compare it with the square knot.

Make the granny knot, and see how easily it slips and unties. It is not a safe knot.

5. The *surgeon's knot* is a modified form of the square knot. In making the surgeon's knot, twist rope twice which prevents



FIG. 119. — Surgeon's knot.

it from slipping, and then tie rope with one twist as in the square knot. It is used, as the name indicates, by surgeons.

6. *Figure 8 knot*. This knot is made by making a loop in the rope by passing the end *a* over the part labeled *b* at *X* as shown in Figure 120.



FIG. 120. — Figure 8 knot.

The end *a* is then passed beneath the standing part *b* and is brought back through the loop as shown in the figure above.

7. *Bowline knot*, one of the best knots, is easily tied and untied, and does not slip. It is used on farms, in construction work, and in almost every line of industry. Sailors use this knot in fastening the line of the bow of the vessel when mooring, and therefore the name.

The bowline knot is made by passing the end of the rope, *a*, through a rope or around a post. A half hitch is made. The

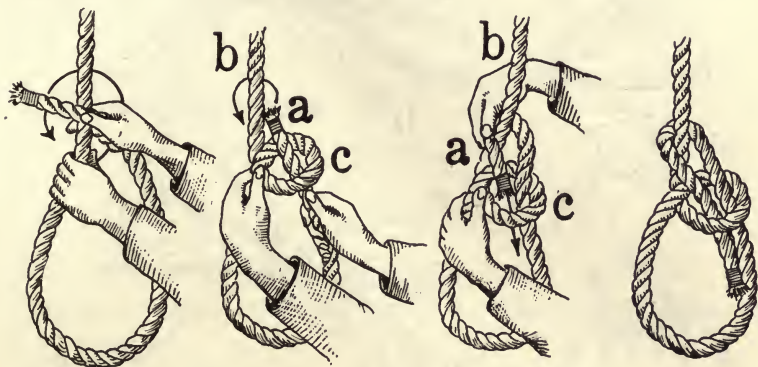


FIG. 121. — Bowline knot.

end *a* is then passed and brought through the loop *b*. Then the end *a* is passed over the standing part of the rope at *c*. Next the end *a* is passed back through the loop *b*. Then the rope is tightened. This completes the bowline knot.

8. *Miller's knot*. The miller's knot is used by millers to tie sacks. This knot is used because it is easily tied and untied, and because it does not slip. The illustration in Figure 122 shows how the miller's knot is tied.

Some useful splices. — Broken ropes may be mended and spliced so that they may continue to be used. Hayfork ropes although new may be accidentally broken, and a knowledge of

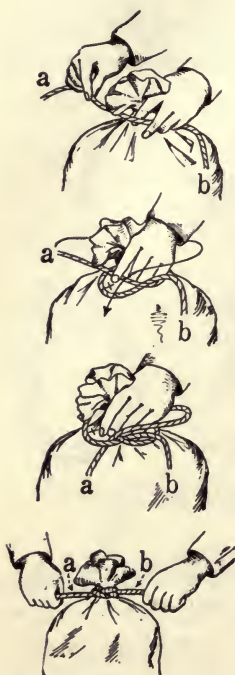


FIG. 122. — Miller's knot.

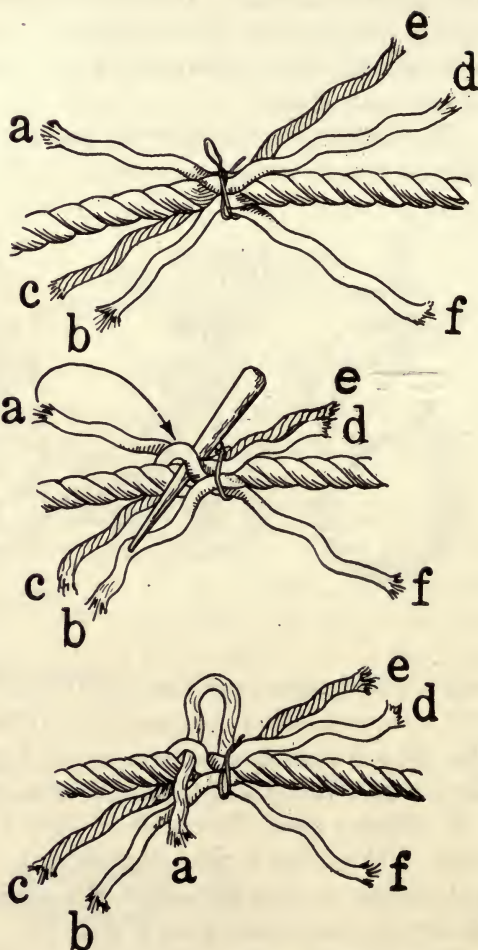


FIG. 123. — Short splice.

how to splice a rope saves time and makes possible the continuance of the work. There are two kinds of splices: the *short*

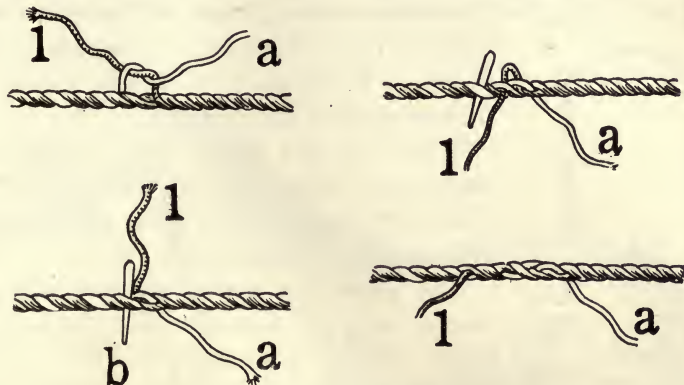


FIG. 124. — Long splice.

splice and the *long splice*. In making the short splice 6 to 8 inches of the rope is spliced together. Figure 123 illustrates the short splice.

The short splice is used in tying halters and in making halters.

The long splice is used where more strength is required, as in cables and hay-fork ropes. The long splice is made like the

short splice. In a $\frac{1}{2}$ -inch rope untwist the strands of the rope 14 to 16 inches, then twist together securely as shown in Figure 124.

The *eye splice* is also convenient and is used in a great many ways. The preceding cut shows the eye splice.

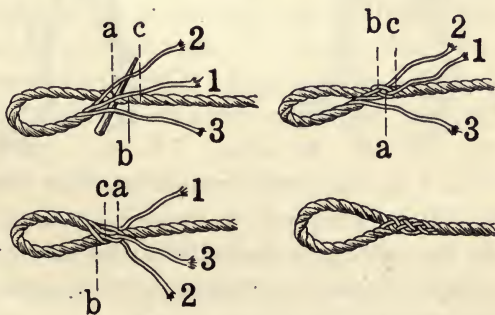


FIG. 125. — Eye splice.

Rope halters. — Halters made of rope are less expensive than leather halters and are more secure. Halters are usually made of $\frac{5}{8}$ -inch rope, and it requires about 13 feet of rope to make a halter. This allows for a nosepiece of 14 inches, a headpiece of 36 inches, a lead and tie rope about 7 to 8 feet long.

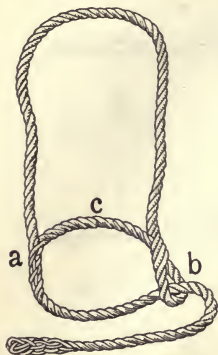


FIG. 126. — Single-loop halter.

There are two kinds of loop halters: a single-loop halter and a double-loop halter. The single-loop halter is made with a single loop as shown in Figure 126.

The single-loop halter will not slip nor loosen, and is therefore not adjustable. Since it is not adjustable, it will be necessary in making it to fit the nosepiece and headpiece on the animal's head before completing it.

The double-loop halter is adjustable and can be made any size, but it is not satisfactory for continuous use because it may become loose and slip off the head. The double-loop halter is made by making an eye splice at one end of the rope. The loop splice should be just large enough to allow the rope to pass through it, but not too large, for this will cause the halter to loosen too easily. Figure 127 illustrates the double-loop halter.

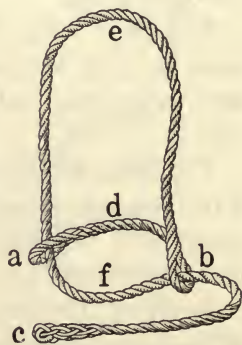


FIG. 127. — Double-loop halter.

Device for halter pullers. — Horses tied with weak leather or other weak halters often form the habit of pulling and breaking the halter. When this habit is once formed it is like other habits in horses, — difficult to break. The shown method of

tying, in Figure 128, is the most effective means devised to change the horse's habits because he will fail to break the rope, and a different habit will be established in the horse.

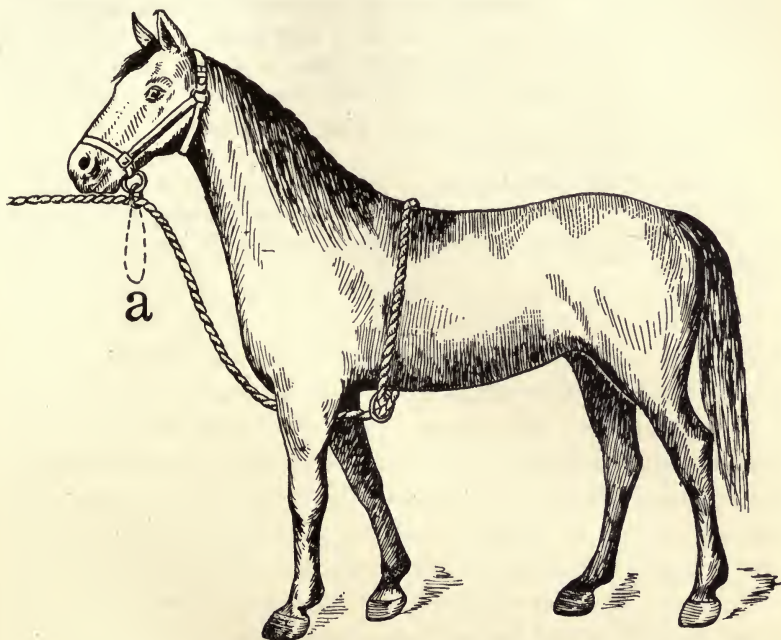


FIG. 128. — Effective device for halter pullers.

Summary. — Every person ties some knots every day, and the knowledge how to tie the right knot at the right time is important information. Farm animals are occasionally strangled because the wrong knot is used, and sometimes the lives of persons are endangered because of the misuse of knots. Practice in the tying of various knots will be both interesting and practical and very helpful in giving a proper understanding of the use of rope work.

LABORATORY EXERCISES AND HOME PROJECTS

1. Have a knot-tying contest. See who can tie and name the greatest number of knots in 15 minutes the first day. Try the same exercise again on subsequent days. Continue to do this for several days until considerable perfection is attained. In this work use a rope about $\frac{1}{4}$ inch in diameter.
2. Make the short and long splice. Take some rope home and have your father make these splices. He may have need for them in his farming operations.
3. Make a single-loop halter.
4. Make a double-loop halter.
5. Have some person who is proficient in rope tying demonstrate to the school how to make various knots, and explain the use of the various knots made.

CHAPTER XV

FARM HOME CONVENIENCES

Need for home conveniences. — In America to-day we realize that the farmers and their families have been so engaged in making a living that enjoyment has been neglected. Living in the country must be made to appeal to young people and especially to the ambitious farm boys and girls. Country life has more to recommend it than life in any other kind of a community, provided the young people can be made to realize new ideals of living and their own social worth and importance. The attractiveness of the farm home and scientific home making will have as much to do with keeping young people interested and contented as scientific farming. Affairs of the household, as well as routine farm work, should be managed in such a way as to give time for social and cultural improvement.

We find fewer conveniences and modern labor-saving devices in the farm home than in any other place in the rural community. The housework is unattractive and exhausting, for the equipment is poorly selected and arranged. The preparation of food and the washing of clothes are much more of a burden than they should be. The farmer buys good machinery to produce and harvest his crops, but in the farm home labor-saving equipment is almost unknown. It is possible for the farm women to have the conveniences that the city women have enjoyed so long, — running water in the house and electricity from a home electric plant to do the washing, ironing, sweeping, and churning as well

as to light the home. Beautiful and sanitary surroundings make for better home and health conditions. These are possible in every home, since they involve in most cases very little extra expense and labor to provide them and pay for themselves a hundred fold in improved health and happiness in the family life. Such improvements instill in the family group a love and

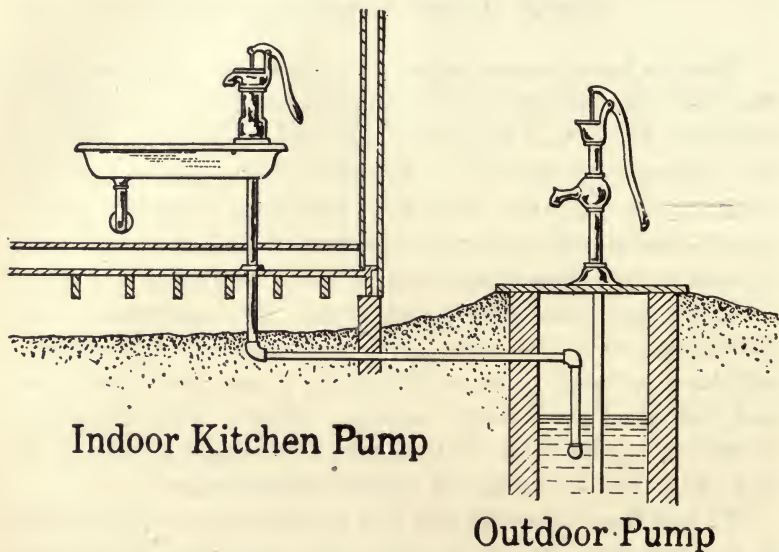


FIG. 129. — Simple pump used in pumping water into the kitchen.

appreciation of life in the country that will never exist in the old inconvenient farm home.

In no home is there so much work to be done as in the farm home, and it is very necessary that all the members of the household coöperate. House labor must be made less exhausting by making such improvements in the home as are possible with the amount of money available and by using thought and foresight in locating as well as selecting equipment.

Water supply for the farm home. — Good water is as essential to life as good food. Each individual in the home requires for drinking and cooking about one gallon per day; for washing and other purposes at least 16 gallons per day. On most farms the water is obtained from wells, cisterns, or springs, and must often be carried for a considerable distance. After it has served its purpose, it must be disposed of and often must be carried out of the house again. It is surprising how much energy is wasted

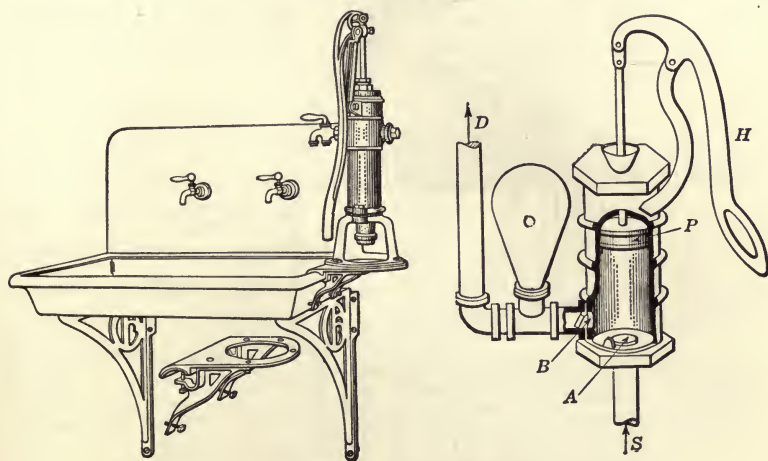


FIG. 130. — How the house pump is attached to the kitchen sink.

to-day by these processes, even though we have efficiency experts in factory and home, working to eliminate useless waste of human life and energy. The poorest home can have some kind of a sink with satisfactory pipes to carry away the waste water from the kitchen. Most homes can also have some kind of a pump to lift the water from well, cistern, or other source of supply, into the kitchen. The amount of money available, and the size of the house and the family will determine the kind of water system; but the important thing is to get one of some kind into

every farm kitchen in this country so that good clean water is easily available at all times. Various types of equipment and the advantages of each will be discussed.

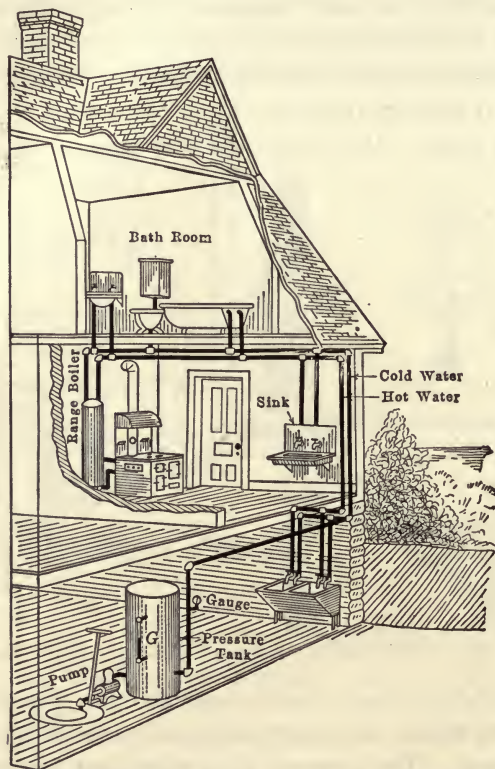


FIG. 131. — How the pressure tank system of water appears in a dwelling.

1. When the cistern or well is near the house the simplest and cheapest method is to place a *kitchen* or *lift pump* over the sink in the kitchen.

2. The *house force pump* is more expensive but also much more satisfactory than the lift pump, for it furnishes a steady stream

of water instead of an intermittent one and it provides a limited amount of water under pressure.

A pump of this type may be used in connection with a tank in the upper part of the house to furnish water for both the kitchen and bathroom for a small family. It does not require too much effort to work the pump; and if a few spare minutes each day are given to pumping, a satisfactory water supply can be maintained.

3. For larger houses or where a large amount of water is required a regular *tank pump* may be installed. The chief danger is from freezing, if the tank used is in the attic of a house in a very cold climate. If extremely cold weather is probable, then the pressure-tank system is more satisfactory.

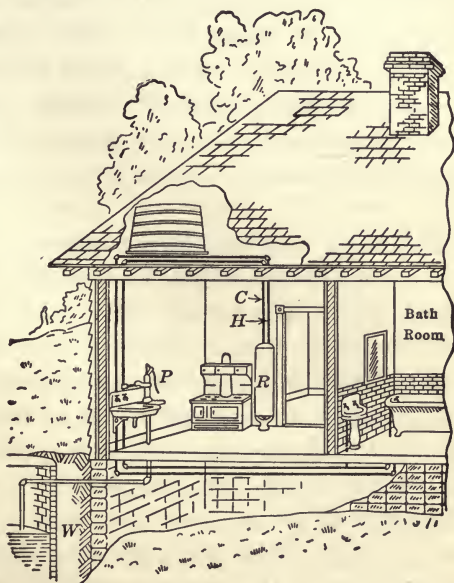


FIG. 132. — A water tank which supplies water to the entire house by gravity.

However, the house force pump with an elevated tank has often been used to supply water for kitchen, bathroom, and hot water furnace in an average-sized house for an average-sized family; and such a system is cheaper than the pressure-tank system.

4. Of course the system may be made more satisfactory and a larger amount of water may be supplied by installing a *gasoline engine*, *wind mill*, or *electric motor* in connection with the plant.

This reduces the labor because hand pumping is not required, but efficient hand-power water systems are to be recommended for the average home when cost has to be considered.

Heating systems. — Because of the drudgery it would save and the comfort it would give, a heating system is probably next in importance to a water supply. Many farm women must carry into the house fuel to feed several stoves when heat is needed, and must carry out the ashes, and clean up the dirt caused by these stoves in various rooms of the house. This condition could be greatly improved by some type of modern heating plant which would keep the whole house usable during the winter with a minimum amount of labor, and it would add much to the comfort and convenience of the whole family.

1. The *hot air* heating plant is similar in principle to a jacketed stove except it is usually put in the cellar and the warm air is distributed by pipes. The stove part has its fire box, smoke flue, ash pit, and draft, and the mechanism of this part, so far as the fire is concerned, is not affected by the air chamber. The front of the stove forms the outside of a part of the air chamber, which is made of brick, iron, or galvanized iron. Near the bottom of the air chamber the fresh-air conduit enters and admits air from out of doors. This air is heated and then carried through pipes to registers in the various rooms of the house. A hot air furnace has these advantages: (1) It gives quick heat. (2) It gives moist air when a special apparatus for furnishing water for evaporation is installed. (3) It is cheapest to install. The disadvantages of such a furnace are: (1) The rooms on the windward side of the house are hard to heat. (2) The pipes take up a great deal of room in the basement. (3) There is the possibility of escaping coal gas. (4) Dust may be drawn into the air chamber and scattered through the house. This type of heating plant is best suited to a small compact house. For heating the small

house, however, the pipeless furnace is now becoming popular chiefly because of the low cost of equipment and installation.

2. *Steam* heat is best for large houses and buildings, but is not satisfactory for the average home. No heat at all is given to the radiators unless the water is kept at boiling point or above. The temperature is too high while circulation continues, and circulation stops as soon as the fire goes down; so such a system is never suitable for mild weather. There is more mechanism to the steam system than any other, and it requires greater skill to manage it. It is as a rule more expensive to operate than the hot water system.

3. *Hot water* heating is usually considered best for homes, as the water in the radiators can be heated to any temperature up to boiling; and the water will continue to circulate as long as it is warm, even though the fire gets low or goes out. It is much less affected by winds than the hot air system and there is less danger of overheating than with steam heat. The pipes cannot carry dust and odors; the plant is considered easy to operate; and while the cost of the plant is high, the operating expense is low. Some provision must be made for ventilation when hot water or steam systems of heating are used. A combination of warm air and hot water has the advantage of ventilation and easily controlled heat. Sometimes radiators are inclosed with space for fresh air to enter at the bottom and space for heated air to escape near a window. Air in the heated house is apt to be too dry for comfort and health. Warm air will take up more moisture than cold air; and in cold weather, even though the air out of doors is moist, the air inside will be dry when heated to a comfortable temperature. If no moisture is supplied, it will be drawn from the woodwork, the furniture, and our bodies; and we shall feel chilled even though the temperature of the room

is raised quite high. Water to be evaporated as the temperature rises should be provided in all parts of a heated house.

Lighting the home. — One of the most important farm conveniences is a good lighting system; and although it costs money to buy and install such systems, they will pay for themselves by the added convenience and comfort and by decreasing the number of shortsighted children.

1. The *kerosene lamp* was a great improvement over tallow candles and dips, but there is no excuse for continuing the use of the flat-wick lamps when better systems of lighting are available. The lamp is objectionable because of its odor, the heat it develops, and the smoke. It requires a great deal of attention and consumes much oxygen. The kerosene lamp with a mantle costs more than the old wick lamp, but it is a great improvement so far as lighting is concerned. It gives more and better light and is almost odorless, but must be handled carefully, for the mantle is very fragile.

2. *Gasoline* is used as a source of gas for lighting. The gasoline light is the cheapest to operate but is dangerous and must be carefully used, because gasoline continually gives off inflammable vapor. The gasoline portable lamp gives a fairly good light, but should always be filled by daylight, and the supply of gasoline should be stored outside of the house. Gasoline may be piped to the lights or the gas may be piped, but in any case the gasoline lighting plant is considered dangerous and especially so if the tank is located inside the house.

3. *Acetylene gas* has been used in many farm homes for lighting. It is less dangerous than gas from gasoline, but it is more expensive to operate the lighting plant. Calcium carbide is used to produce the gas. It decomposes rapidly when it comes in contact with water, giving off the gas called acetylene, which is piped to the light fixtures. It is necessary to keep the supply

of calcium carbide in air-tight, water-tight containers. Care must be used in installing and using this type of plant. The outdoor plant is safer than the kind that has the generator indoors.

4. *Electric lighting* and electric conveniences have not been available for most people until recently because the commercial generating plant was the only important source of electric current for many years. There are now available a number of small

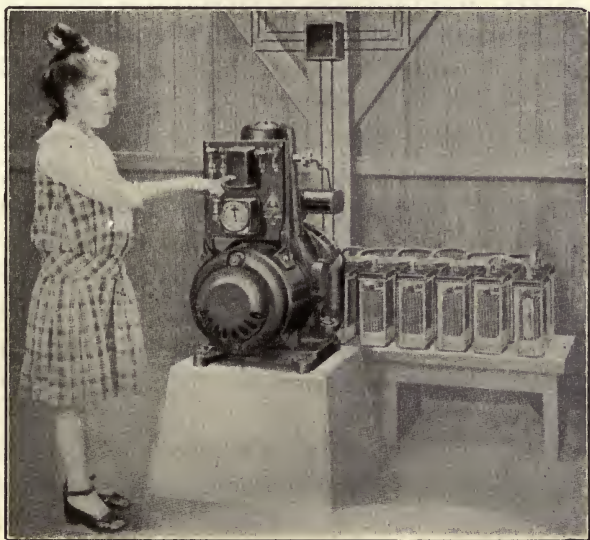


FIG. 133. — Plant for generating electricity.

electric generating systems that are suitable for supplying the rural and farm home with electric energy for all home conveniences. The gasoline engine is no longer necessary in order to supply electricity, and the modern private electric plant is small and compact, easily operated and controlled. The farm home may now be as well lighted as the city home and at a minimum cost. It is no longer necessary to waste time cleaning lamp

chimneys and filling lamps or to do without adequate light for every member of the home. The initial cost of the modern electric lighting system is small compared to the convenience and comfort derived from it.

A plant similar to the one in Figure 133 would be satisfactory for supplying the average farm home with electricity for all ordinary uses.

Other electric conveniences. — When the private electric plant has been installed much of the drudgery of the farm home can be readily eliminated, for there are on the market to-day a great many electric conveniences that can be secured at moderate cost and that will prove great time and labor savers in the home, just as power machines are time and labor savers for the farmer in the field and machine shop. Power for such everyday tasks as sweeping, ironing, washing, sewing, and churning will relieve the farm woman and will give her time and energy for developing along intellectual and cultural lines, for the care and training of her children, and for the bringing of progressive ideas into the community. These conveniences are discussed in succeeding paragraphs.

Laundry equipment. — Count the number of steps saved and the amount of energy conserved by using the electric washer with wringer attached for doing just one week's washing; then multiply those figures by fifty-two to find out whether it is worth while to provide such equipment, even though it involves some sacrifice to supply the money. There are a large number of washing machines on the market, but one of the best types is that with the revolving wooden cylinder for holding the clothes. It is simple in construction, easily operated and does satisfactory work. Much of the drudgery of washing vanishes when permanent plumbing is installed, for the drudgery has less to do with the washing of garments and the removal of dirt and germs than

with lifting and emptying water. It cannot be urged too strongly that the farm-home laundry be fitted with running water and a drainage system at least, and when possible with washing machine and wringer. No investment will pay better dividends in saving of health and strength.

The ironing board should be steady and of the right height to allow the worker to exert pressure with comfort. The point of height must be kept in mind as much in laundry equipment as in kitchen equipment. For years women have stooped over sinks and tables that were too low, strained their muscles over ironing boards that were too high, and stretched for utensils on high shelves out of reach, thus increasing the strain and fatigue of the tasks. The electric iron saves steps and energy. It is by far the greatest labor saver of any single piece of laundry equipment.

Equipment for cleaning. — In the old methods of sweeping and dusting, the work was done in such a way as to scatter dust from one place to another. To-day we have available equipment for new methods which involve dust absorption rather than dust scattering. Instead of the broom and feather duster we have the vacuum cleaner and the dustless duster. Every home should have a definite place for the important tools of cleaning. In the farm home the best place is a closet on the back porch or at the head of the cellar stairs, high enough to accommodate long-handled mops and brushes, and with floor space for scrub buckets and shelves for bottles and cleaning compounds and powders.

If there is a home electric plant, the electric sweeper can be used, and there are a number of quite satisfactory hand power cleaners that are easier to use than the broom and do the work much better. For bare floors strong-handled mops are best, but for carpets and rugs the vacuum cleaner is most suitable because it prevents scattering of dust and does the work more

thoroughly than any other device. There is practically no tool used for home cleaning that cannot be mounted on a handle, and it will give better results with less effort when so used. By the use of handles it is possible to sweep, mop, dust, or scrub without stooping and with less effort. The longer the handle the straighter the position of the worker and the easier the work will be done, for the handle acts as a lever for the exertion of greater pressure. One hand is used chiefly to direct the handle while

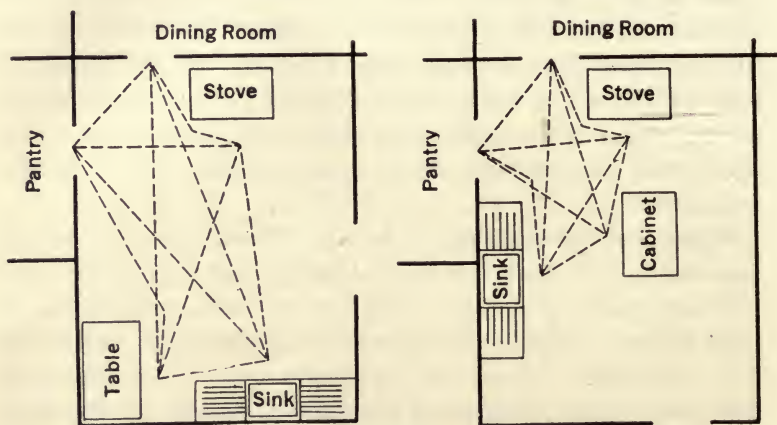


FIG. 134. — A kitchen arranged as shown in right-hand plan saves many steps.

the other gives the real force. Even dust pans have been placed on handles. By modern methods work can be made to serve as a valuable exercise that develops the muscles of the body, rather than a drudgery that deforms the body and tires the muscles and nerves.

Farm kitchen. — About 70 per cent of the housekeeper's day is spent in and about the kitchen. By careful planning most kitchens can be made to suit the special needs of the housekeeper, so that she can do her work and not be tired and overworked,

but will have time and energy left after the day's work is done. Important factors in lessening kitchen tasks are:

1. *Arrangement.* The kitchen should be well lighted and ventilated. Windows should be placed on at least two sides and be so arranged that all working surfaces are lighted and the worker does not stand in her own light. The stove, sink, and work tables should be placed near each other so as to reduce the amount of walking required to do the necessary work.

2. *Stove.* A coal or wood range is the most satisfactory for a farm kitchen if there is no furnace. When the heating does not need to be considered, the best method is to supply a cooking device that consumes fuel only while the actual cooking is in progress. Stoves using gas, electricity, or oil are the best. For the farm kitchen the oil stove is most widely used because gas is not available and electricity is usually too expensive. In summer the oil stove is a necessity if comfort and convenience are considered, for it greatly reduces the temperature of the kitchen and can be cooled quickly when the cooking is finished.

3. *Fireless cookers* reduce fuel cost, lessen labor and time and cook foods with little loss of weight. They make necessary planning and forethought, and require intelligence, care, and some experience to get good results. Some foods are improved by such long cooking at low temperature. The fireless cooker does not brown food as well as an oven and unless it is used often the fuel and time saved do not justify the investment. For a farm woman who has tasks out of doors or who is away from home frequently it is a great help, for she does not have to worry about results while she is doing other tasks, and when mealtime comes the food is ready to serve. There are a number of manufactured fireless cookers that are widely used, but a handy man in the home can manufacture one that will cost less and do the work as well.

4. *Kitchen cabinet.* No one piece of kitchen equipment does more to save time and energy than the kitchen cabinet. A homemade kitchen cabinet can be built with moderate cost if it is not necessary to secure outside labor. If both material and labor must be purchased a ready-made cabinet will cost no more than the homemade one. When used with a high stool, the cabinet saves endless steps, for the worker has within reach all the supplies and all the utensils necessary in most cooking processes. The best type has containers for flour, sugar, cereals, and spices, space for storing utensils, drawers for tea towels and cloths, racks for covers, and adjustable bread board. When the expense of a cabinet seems too great, the work table may be placed against the wall and shelves may be arranged above it to hold supplies, with a row of cup hooks for holding cooking utensils.

5. *Work table.* No one surface can serve for several processes without extra handling and confusion; so in addition to a kitchen cabinet a work table should be provided to hold hot dishes and soiled utensils. This should have a top that is easily cleaned and should be so placed that steps will be saved when working at the cabinet, stove, or sink.

6. A *stool* of a proper height for use at the cabinet, stove, sink, or table and light enough to be easily moved from place to place will save foot and back aches. Quicker and better work can be done after the worker has acquired the sitting habit. No absolute height can be given for working surfaces, but if people who are to use the equipment vary in height it will be best to arrange them to suit the tallest worker and supply a stool or platform upon which shorter workers may stand.

7. *Sink.* Too often in the past sinks and tables have been too low for comfort, causing unnecessary bending over the tasks and increasing fatigue. Sinks especially are always installed

several inches too low unless the housewife insists that the height be increased to 34 or 36 inches. The sink should be deep enough to give ample room for dish washing and should be built with drainboard and back all in one piece and the drainboard at the left if only one is provided. The plumbing should never be

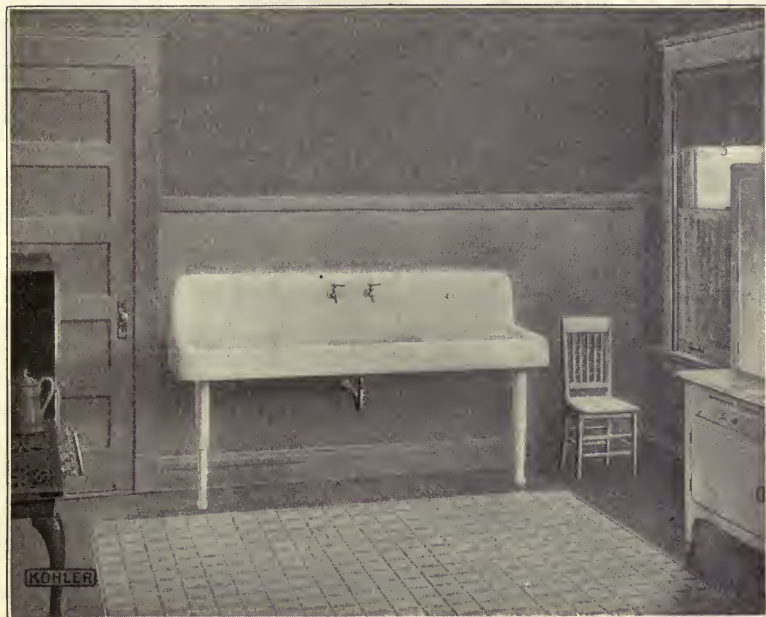


FIG. 135. — A white enamel kitchen sink.

closed in, because this furnishes a breeding place for insects and cracks for accumulation of dirt.

Bathroom equipment. — It is just as necessary to have clean bodies as it is to have clean food and clean water to preserve health. The average farm home is a considerable distance from doctors, nurses, and hospitals; so in case of sickness the farm family may have to act unaided. How can one expect a normal,

healthy family to exist where no arrangement is made for keeping clean except the wash basin and towel in the kitchen or back pantry?

It is not necessary to spend a great deal of money in order to have a convenient place for keeping clean and to make provision for an entire bath. No great amount of money is required to furnish a clean, attractive, and convenient room, similar to the model bathroom for the average dwelling shown in Figure 136.



FIG. 136. — Model bathroom for a country home.

Summary. — It is evident that the amount of money available helps to determine the kind of equipment that can be provided for lightening work in the farm home; but too often lack of knowledge concerning what to provide and lack of foresight and planning in selecting and placing equipment, as well as in using it, are responsible for the fact that farm mothers grow old and worn out before their time and farm boys and girls go to the city in search of conveniences and entertainment.

If the farmer will buy for his home as many conveniences as he buys for doing his outside work, his wife will have time and energy for mothering and entertaining their children, for creating the right home atmosphere, and for so enriching home surroundings that the children may gain their ideals of beauty and their tastes from home, with its books and good music, rather than from picture shows, jazz bands, and bright city streets.

LABORATORY EXERCISES AND HOME PROJECTS

1. Visit homes containing different kinds of heating plants and have the parts of these and their working principles explained to you. Determine as accurately as possible the comparative cost of installing the various plants.

2. Visit homes that have electric-power plants and have the machinery explained to you by the owner; also the conveniences that are operated by the power.

3. Make a floor plan of your home kitchen and figure as nearly as possible the distance traveled by a person preparing some one food for the table. (For instance, making apple sauce.)

4. Rearrange the equipment in the above kitchen so that the number of steps required will be decreased.

5. Plan what you would consider a model farm kitchen.

6. Secure from manufacturers descriptive literature and price lists for required farm-home conveniences and calculate the approximate cost of a kitchen you would consider satisfactory.

7. Determine what are the commonest home conveniences used in homes in your community: the most needed in order to lighten the home work.

What one could be supplied at moderate cost if people realized the need for such conveniences?

CHAPTER XVI

FARM MACHINERY

From hand labor to the use of machinery. — No factor has played a greater part in the advancement of farming than the use of machines. For many centuries farm work was done by hand or with the very simplest implements. The wooden plow, the scythe, the flail, and other simple tools continued in use until about 1850. The area tilled was small. The working day was long. The output was small, and the total production per man was very limited. But to-day machinery has revolutionized farm work. The gang plow, the self-binder, the cultivator, and various other machines assist the farmer in producing cheaper food. It is estimated that the binder will do the work of 25 or 30 men; the cotton gin, the work of 50 or 60 men; and the gang plow is limited in the work it will do only by the propelling power which draws it. The use of machinery has reduced the cost of production, increased yields, shortened the day, and provided time for recreation and reading. Farm machinery has emancipated woman from hard manual labor, and has made the farm a much more agreeable place to live.

Money invested in farm machinery. — Money on farms is invested in land, buildings, implements, and live stock. The 1910 Census showed that on all farms in the United States 70 per cent of the capital was invested in land; 15 per cent in buildings; 3 per cent in implements; and 12 per cent in live stock. Since land and live stock are real productive capital it is important that the major portion of the total capital should be invested in

them. Yet adequate machinery is essential to the economic production and handling of farm crops. The amount of capital invested in machinery on the general farm ranges from 2 to 4 per cent of the total capital invested. To invest much more than that on the general farm is a mistake, for it usually results in increasing the cost of production.

Kinds of machinery and tools. — There is a machine for every kind of farm activity ; tilling, seeding, haying, harvesting, and other processes. Plows, harrows, weeders, rollers, drags, and cultivators are tools used for tilling the soil. Each tool and implement comprises several kinds. Thus there are different kinds of plows. There are walking, riding, sulky, gang, and disk plows. There are various kinds of harrows, weeders, and cultivators.

Seeding machinery consists of drills, seeders, and planters of various kinds.

There are harvesters for almost every kind of crop. The wheat harvester and the wheat header are indispensable on the wheat farms and ranches. The corn harvester and the potato digger are labor saving machines.

Haying machinery consists of mowers, rakes, tedders, loaders and track, and hayforks.

Other machines, besides those mentioned above, are : manure spreaders, silo fillers, shredders, balers, stackers, threshers, pressers, stump pullers, and engines of various kinds.

The study of the parts of machines is both interesting and profitable. Thus the plow has the following parts : moldboard, share, landside, beam, handles, clevis, and frog.

There are perhaps fifty or more small tools used on the farm. Cutting tools include knives, shears, saws, chisels, axes, hatchets, and others. There are some tools used to increase power or to secure mechanical advantage. The lever, the pulley, the block and tackle, and the wedge are all used to secure mechanical

advantage. Thus a block and tackle multiplies the pulling or lifting power as many times as there are strands of rope minus one. A man weighing 200 pounds pulling on a block and tackle having 5 strands of rope can lift almost 800 pounds. If there were no friction, he could lift exactly 800 pounds.

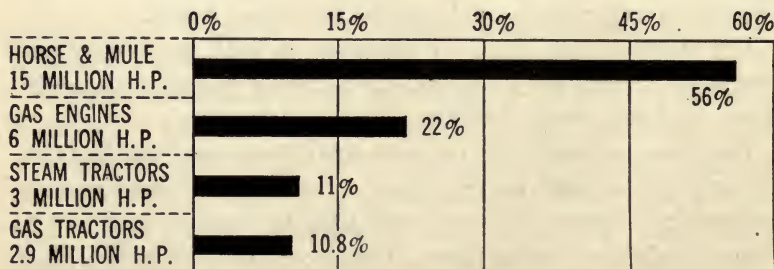


FIG. 137. — The block and tackle helps to multiply man's power.

These machines and many others not named constitute a part of the farm equipment and help much in making farming easier and more agreeable.

Things that reduce the pull on machinery. — There is more horse power used upon farms than all other power combined. From Vocational Rehabilitation Bulletin, Series No. 36, we gather the following data.

Expressed in terms of horse power the horses and mules used on farms in the United States furnish 15,000,000 H.P.; steam tractors 3,000,000 H.P.; gas tractors 2,900,000 H.P.; and gas engines 6,000,000 H.P. In all manufacturing establishments there is used 27,000,000 horse power. Graphically the horse power used on farms in the United States may be shown as follows:



GRAPH 5. — Horse power used on farms in the United States.

The above data and graph are self-explanatory. They show that the horse, an animate thing, still does the most work on farms and therefore it is important for us to use machinery so constructed that it is easily pulled.

There are several things which reduce the pull on machinery. High wheels decrease the draft. High wheels on wagons, cultivators, riding implements of any kind, rollers, disk cultivators, and disk harrows aid in reducing the pull. Roller and ball bearings serve the same purpose. A cultivator with eight shovels, each two inches wide, will pull easier than a cultivator with four shovels, each four inches wide. A 16-inch plow pulls almost twice as hard as a 12-inch plow. A shovel with a very slanting shape will pull easier than one which plows an equal depth but stands more nearly erect.

A sloping moldboard pulls easier than one set more nearly erect. An abrupt moldboard pulverizes the soil more, while the furrow slice is not pulverized very much by a moldboard which turns the soil quickly, but which does not pitch the soil so high. Rolling coulters and cutters aid materially in reducing the pull on plows used in turning a turf soil. It was found by J. W. Sanborn at the Missouri Station that a plow making a furrow 14.5 inches wide and 5.3 inches deep required a draft of 4.4 per square inch. But when a rolling coulter was used the draft was reduced to 3.5, or about 75 per cent of the draft when no coulter was used. It is almost unnecessary to say that lubrication may reduce the draft at least 25 per cent in many instances.

Care of farm machinery. — The life of the average machine is about 7 or 8 years. In a survey made at the University of Minnesota it was found that in a year's time harrows depreciated 8.72 per cent; reapers 1.13 per cent; mowers 7.8 per cent; corn cultivators 7.25 per cent; corn planters 7.15 per cent; walking plows 6 per cent; disks 5.19 per cent; hay loaders 11.78 per

cent; manure spreaders 11.67 per cent; threshing outfits 12 per cent; and corn binders 10 per cent. Farmers' Bulletin No. 303 states that a corn binder lasts on the average 8.17 years. The annual depreciation, therefore, is 12.2 per cent of the original cost.

Complicated machinery, such as threshing outfits, hay loaders, manure spreaders, corn binders, tractors, and automobiles, depreciate more rapidly than do simple machines such as plows, sleds, wagons, hay tedders, grain tanks, and harrows.

The care of machinery divides itself into four parts: (1) housing, (2) repairing, (3) painting, and (4) lubrication.

1. An implement shed will often double the life of a machine, while exposure to all kinds of weather shortens materially not only the life of the machine, but its usefulness as well. Machinery housed in an implement shed and oiled well before it is put in the shed may be used efficiently the day it is taken out for use; but a machine which is rusty gives much trouble, often results in unnecessary repairs, and will not do efficiently the work for which it is intended. An implement shed built high and dry pays for itself in two or three years. An implement shed that will house \$1000 to \$1500 worth of machinery need not cost more than \$300 or \$400. It should be built with a self-supporting roof, and the interior should not have studdings or anything else in the way.

2. The care of machines by way of repairs is very important. Ordinarily repairs should be made when needed; but some repair work may be done in the winter months when other work is slack. It is suggested that the repair shop be made a part of the implement shed, and that the tools needed for repair work be kept there also. When implements are put into the shed for winter housing they should be looked over and all parts needing repairs should be noted on a tag, and the tag should be tied to the

machine so that when repair day comes no time is lost in learning what parts need to be repaired.

3. Painting machinery not only protects and preserves it but improves its appearance as well. Iron and steel are protected against rust by paint, and wood is protected against decay. Both wood and steel remain stronger when they are painted. A good grade of paint should be used in the painting of farm machinery.

4. Proper lubrication protects against wear of the important parts of a machine, and also lessens friction, and, therefore, the pull. Proper lubrication is the cheapest and easiest way to keep machines in good running order. The kind of lubricant used depends upon the pressure upon the part lubricated. For light pressure a thin oil is used; for heavy pressure a heavier oil is used; and for a wagon heavy grease is the best lubricant. Self-oiling boxes on machinery are both convenient and efficient.

Economical use of machinery. — Most farmers have the amount, kind, and size of machinery needed for their farm work. Yet it is true that much machinery is bought every year. Often new machines that soon go out of date are bought. Every machine goes through a process of evolution. Tractors, automobiles, milking machines, harvesters, plows, and various other machines used 10 years ago have been superseded and replaced by improved machinery.

The well-to-do farmer may buy such machinery as he needs, but the renter and the average farmer may often purchase at a bargain at public sales good useful machinery at a low price. In estimating the cost of machines, depreciation, repairs, cost of housing, interest on money invested, taxes, and oil should be included. Since often a secondhand machine may be purchased at a low price, it is evident that the depreciation, interest, and tax are less than on high-priced new machines. The total cost

of farm machinery on a farm should be kept within reasonable limits.

Sometimes a machine is bought for a small farm where the number of acres upon which it is used does not justify the purchase of an expensive machine. For illustration, if a tractor costs \$1000 and can be used only on 25 acres, its purchase is not justifiable. The life of the tractor is 8 years; therefore, the annual depreciation is \$125. The interest on \$1000 at 6 per cent is \$60. The amount of depreciation and interest, or \$185, charged against 25 acres, makes an acreage charge of \$7.40. This is a prohibitive overhead charge against the land, and hence a \$1000 tractor should not be purchased where it can be utilized on only 25 acres. Likewise large drills, harvesters, plows, and harrows should not be purchased unless the acreage on which they can be used justifies their purchase.

Neighborhood ownership of machines. — Expensive machines that are used only a few days in the year may often be purchased and used by the farmers of an entire neighborhood. Thus, wheat drills, self-binders, silage cutters, shredders, corn binders, gasoline engines, motor trucks, and other expensive implements may be purchased and used by several farmers jointly. This reduces the cost of the machine per acre on which it is used, and lowers the pro rata depreciation, interests, housing, repairs, and other fixed charges. A large farm containing 200 acres of tillable soil will often justify the purchase of machines which cannot profitably be purchased on a 100-acre farm. But two farmers each having 100 acres may purchase as much machinery as one farmer having a 200-acre farm. And five farmers, each having 40 acres, need more machinery than one farmer having 200 acres. The farmers having small farms may purchase together for neighborhood use several machines which can not be justifiably purchased by one farmer.

Summary. — The proper investment in and use of machinery is one important factor in economic production of farm crops. Every effort should be made to purchase and use only such machinery as pulls easily and does its work well. Care of machinery consists of housing, repairing, painting, and lubrication. The amount, size, and kind of machinery purchased and used affect the economic production of farm crops. The question which should be asked in the purchase, use, and care of machinery is: Will it pay?

LABORATORY EXERCISES AND HOME PROJECTS

1. Go to some farm and study the plan and method used in housing the machinery. Draw the plan of the implement shed and comment on its arrangement. Can it be improved? If so, how?

2. Go to some farm and study the different kinds of plows and their parts. Observe the size of wheels, and kind of moldboard used. Will they tend to increase or reduce the draft?

3. In a survey of the entire school district itemize the kind, amount, and value of the machinery in use. List the machinery as: (a) tillage, (b) seeding, (c) hauling, (d) haying, (e) harvesting, (f) workshop tools, (g) miscellaneous tools.

4. Discuss the block and tackle when used in (1) lifting animals at butchering time, (2) in pulling stumps, and (3) in moving houses.

CHAPTER XVII

SOME ESSENTIAL MACHINES

Study of machinery.— Every farm should be equipped with such machinery and tools as will aid efficient and economic production. To this end the farmer should endeavor to become acquainted with various makes of the most essential machines and their important differences. He should study new inventions as to their adaptability to his farm and the work that he wishes to carry on. He will also find it an advantage as well as a source of interest to know the story of progress in various kinds of farm machinery.

This chapter introduces such a study with a brief history of one essential implement, the plow; and with the claims of three rather new machines,—the tractor, the gasoline engine, and the milking machine.

Plow.— This implement is simple in construction, yet its evolution extends from prehistoric times to our own day. The first plow was nothing other than a crooked stick. Throughout the Middle Ages and up to the middle of the 19th century little improvement was made in plows. Joseph Foljamb and Jethro Tull patented a plow in 1730. Thomas Jefferson, in 1798, and James Small, in 1802, were the first to discuss along mathematical lines the correct shape of the moldboard. The modern type of plow was patented by Jethro Wood in 1819. His plow had three distinct parts: moldboard, share, and landside. He made a plow of three parts so that repairs could easily be made. Plows up to this time were made of cast iron. John Lane and John Deere, in 1837, substituted steel for cast iron. Daniel

Webster designed and helped to build a plow in 1836. It is represented in Fig. 138.

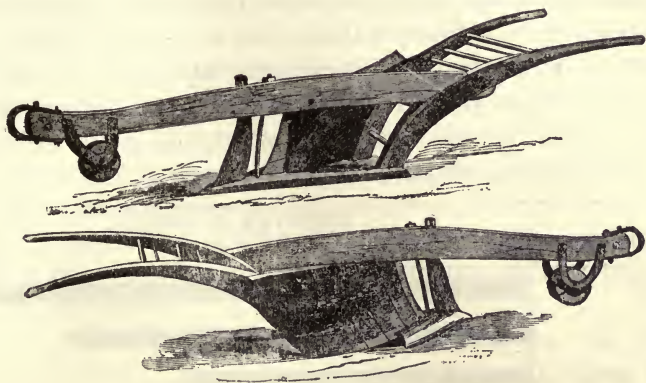


FIG. 138. — Daniel Webster's plow.

The sulky plow was patented by H. Brown in 1844, but it was not improved so that it was practical until 1864. The disk plow was invented by M. A. Cravath and J. M. Cravath of Blooming-

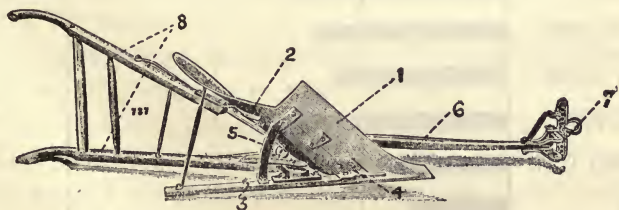


FIG. 139. — Parts of a plow :

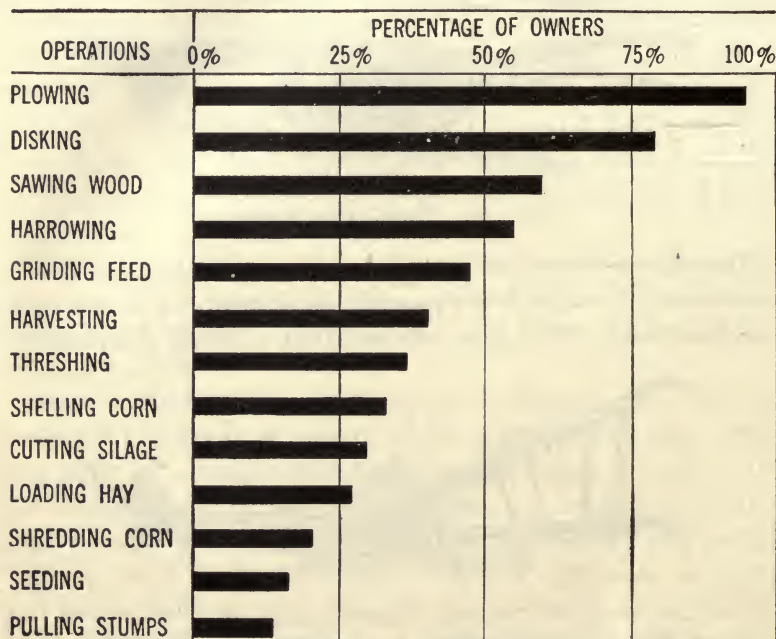
- | | | | |
|---------------|--------------|-----------|------------|
| 1. Share. | 3. Landside. | 5. Brace. | 7. Clevis. |
| 2. Moldboard. | 4. Frog. | 6. Beam. | 8. Handle. |

ton, Ill. The idea of the use of engines for plowing and pulling machinery seems to have originated with David Ramsey and Thomas Wildgosse in 1618. But the practical use of motors in connection with pulling machinery dates from the invention of

Fowler, assisted by Smith, in 1854. The shape of the moldboard, the width of the share of the plow, and the smoothness of the plowshare and moldboard affect the draft of the plow.

The parts of the ordinary walking plow are shown in Fig. 139.

The plow is the first essential tool in the process of crop production. It is used to: (1) invert and pulverize the soil, (2) turn under organic matter, (3) promote nitrification, (4) aid in liberating plant foods, and (5) prepare a good seed bed.



GRAPH 6. — How 191 corn belt farmers used the tractor.

Tractor. — *a. Its advantages.* The tractor has several advantages.

1. It can do heavy work and do it quickly during the proper season. This is probably the greatest advantage of the tractor.

Thus wheat ground may be prepared during the hottest weather, when horses are almost unable to do the work.

2. It saves man labor and does away with hired help to a certain extent.

3. It can do heavy work better. Soil may be plowed deeper and hard soil may be plowed with the tractor to advantage.

4. It may be used for belt power. Tractors are used for a wide range of operations. On 191 corn belt farms, tractors were used as shown in Graph 6.

Seldom do farmers say that the tractor has an advantage in displacing horses in doing work at night and in doing work more economically.

b. Its disadvantages. Although this machine has only passed the experimental stage recently, the disadvantages which farmers most frequently attribute to it are:

1. It packs the moist soil, and therefore the tractor cannot be used until the surface soil is quite dry.

2. It is difficult to get efficient operators. Inefficient operators have a good many breakdowns and are unable to get the best work from the tractor.

3. It is uneconomic on rough land. The tractor cannot be well used on hilly, stumpy, or stony ground.

4. It is unsuitable for small fields. Expense in operation is very much increased by using the tractor on small fields.

Horses are not displaced as much by tractors as was originally thought. On 252 farms where tractors were used, the total horses used before the tractors were purchased was 1321; while after the purchase of tractors there were in use on these 252 farms 1018 horses. This was a reduction of 303 horses, or a displacement of 1.2 horses per tractor.

The use of the tractor has not materially increased crop yields per acre. Although various bulletins state that with the tractor

the soil was plowed $1\frac{1}{2}$ to 2 inches deeper, yet the increase in yield was negligible. Timeliness of plowing probably had a greater effect upon the yield than did deep plowing or superior quality of plowing.

Farmers' Bulletin No. 1004 states: "Judging by the experience of tractor users it is not safe to expect any material reduction in the cost of farm operations per acre through the use of the tractor, but it is safe to expect to be able to increase the crop acreage to a very considerable extent, and, at the same time, the amount of crops which one man can raise."

Tractors may be and are used to quite an extent for custom work. Small farms that do not economically justify the tractors may have some of their work done by a tractor owned by a neighbor. This practice, if convenient to both parties, reduces the cost of operating the tractor to both parties.

Size of tractor to use. — Surveys show that many farms are not large enough to furnish economical employment for the machinery they possess. It was found in a survey of 200 Illinois tractor users, that the minimum farm on which tractors could be economically operated was as follows:

MINIMUM ACREAGES ON WHICH TRACTORS ARE PROFITABLE

SIZE OF TRACTOR ¹	200 TRACTOR OWNERS' ESTIMATES ON MINIMUM SIZE OF FARM ON WHICH TRACTORS ARE PROFITABLE
2-plow	140 acres
3-plow	200 acres
4-plow	250 acres
5-plow	320 acres

Again the 200 Illinois farmers who used tractors had farms with an average acreage as indicated in the following table and used upon these farms tractors of the size shown in the table.

¹ Size of tractor refers to number of 14-inch plows pulled.

AVERAGE ACREAGE OF 200 FARMS ON WHICH TRACTORS OF DIFFERENT SIZES ARE BEING USED

SIZE OF TRACTOR	AVERAGE ACREAGE PER FARM
2-plow	270
3-plow	330
4-plow	365
5-plow	420

Thus the table shows that a 2-plow tractor was in use on farms which averaged 270 acres. This does not mean that tractors were not in use on smaller farms, for they were in use on farms of various sizes.

Cost of operating tractors. — The cost of operating a tractor consists of at least five things: (1) interest on money invested, (2) depreciation, (3) repairs, (4) cost of man labor, and (5) fuel, oil, and grease.

1. If a 2-plow tractor costs \$1000, and the rate of interest is 6 per cent, then the interest charge is \$60 per year.

2. The life of the average tractor is about 8 years. Then the depreciation of a tractor costing \$1000 is \$125 per year.

3. Repairs of tractors vary a great deal under different conditions, and therefore any statement made here must of necessity be very general. The average repair bill for 158 owners having tractors of an average age of 20 months was \$39. For 34 tractors having an age of 32 months, the average repairs amounted to \$79. In fact, the average cost per year for repairs over the entire life of the tractor is about 4 per cent of the original purchasing price of the tractor. The repair cost per year then on a tractor costing \$1000 is \$40 per year on the average. The repair cost is negligible the first year, but after three or four years it is quite large.

4. The cost of man labor is also an important item in running a tractor. The price paid for man labor varies a great deal. It will average close to \$3.50 a day; and skilled labor, which is usually the cheapest in the long run, costs more. Since the tractor is used on the average about 50 days per year it is evident that the cost for man labor will be near \$175 per year.

5. The fuel required for plowing an acre is about $3\frac{1}{2}$ gallons either of gasoline or kerosene. This figure does not vary for different-sized outfits, so long as each pulls a normal load. The amount of fuel used per acre plowed varies a good deal under different conditions. Kind of soil, depth of plowing, and condition of the ground for traction power vary greatly, and therefore the above figure is a very general one. The amount of lubricating oil and grease used also varies widely.

The total cost of plowing an acre, according to the best data available, is as follows: (Farmers' Bulletin No. 1004.)

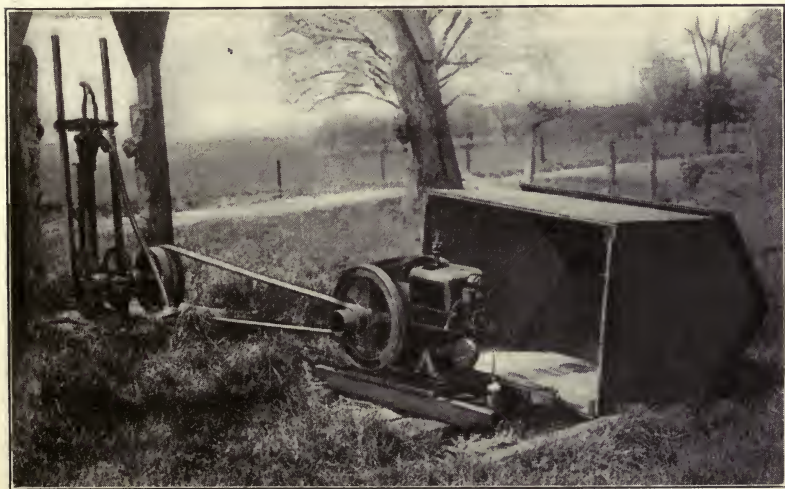
APPROXIMATE COST OF PLOWING AN ACRE WITH 2- AND 3-PLOW TRACTORS.
BASED ON AVERAGE COST OF \$775 AND \$1050, RESPECTIVELY, AND A
LIFE OF $8\frac{1}{2}$ YEARS OF 54 WORKING DAYS PER YEAR

SIZE OF TRACTOR	GASOLINE	OIL	GREASE	REPAIRS	DEPRECIATION	MAN LABOR	INTEREST	TOTAL COST
2-plow	\$0.87 $\frac{1}{2}$	\$0.10	\$0.02	\$0.12 $\frac{3}{4}$	\$0.37 $\frac{1}{2}$	\$0.67	\$0.09 $\frac{1}{2}$	\$2.26
3-plow	0.87 $\frac{1}{2}$	0.10	0.02	0.12 $\frac{1}{2}$	0.36 $\frac{3}{4}$	0.48	0.09 $\frac{1}{4}$	2.06

The table shows that it cost \$2.26 to plow an acre with a 2-plow tractor; and \$2.06 with a 3-plow tractor.

Gasoline engine. — This engine does all kinds of work on the farm and does it at a low cost. The gasoline engine is a great convenience and a great labor-saving machine. It will grind the corn and oats and chop alfalfa or other roughages into a fine meal so that the hog, the cow, or the fowl can eat these

feeds with ease. It will pump fresh water for the cattle or horses. It will furnish the motive power to saw the winter wood. It will turn the shaft which runs the cream separator or produce the vacuum which extracts the milk from the cow. It may run the power sprayer which is used to spray orchards, vegetables, and flowers. It may be used to store or charge the storage battery which lights the house. All of these operations are



Courtesy International Harvester Co.

FIG. 140. — The gasoline engine will do all sorts of work at a low cost.

common jobs on the farm. They require power, some of them more than the average worker can give, and a great deal more than any one likes to exert. However, the gas engine does them easily, more quickly, and at a considerable saving, for it often replaces a farm hand at a small fraction of his wages. The farm conveniences are hardly complete until the gasoline engine is installed.

The gasoline engine may be placed on a solid stationary plat-

form and the shafting and pulleys so arranged that it may be used to do various kinds of work, or it may be mounted on a wagon and hauled to different places, and be made to do even a greater variety of work.

Milking machine.—*a. Advantages of the milking machine.* The milking machine has these advantages: (1) It saves labor. (2) Under sanitary conditions it prevents milk from contamination. (3) Most cows prefer to be milked by mechanical milkers.



Courtesy of Perfection Manufacturing Co.

FIG. 141. — Milking machine in operation.

1. The milking machine saves time and labor. About 15 cows may be milked with a double-unit machine in an hour. The labor of one man may be saved when 25 to 35 cows are to be milked.
2. Under sanitary conditions clean milk can be produced with the mechanical milker. No dust or filth can get into the milk

when the milking machine is used, because the milk is not exposed to the air during the milking. It is conveyed directly into an air-tight vessel through vacuum tubes. Any contamination will be due to the fact that the milking machines and vessels are not thoroughly cleaned.

3. Most cows prefer to be milked by mechanical milkers. The mechanical milker more nearly approaches the natural sucking of the calf than does milking by hand. The uniform pull and the regular, pulsating action of the milking machine are quite agreeable to the cow; while the rough hands of some milkers are not agreeable. Nervous cows may become excited when they are first milked with the mechanical milker. But the average cow, when treated properly, soon becomes accustomed to the milking machine.

b. Success with milking machine. There are three factors worthy of discussion in considering the successful operation of the milking machine. These are: (1) the operator, (2) the machine, and (3) the cow.

1. Some men succeed at almost anything they attempt; others fail equally as often at anything they attempt. The author knows more than one dairyman who has bought a milking machine, tried it for a few months, and then decided that it was a failure. He sold his machine to some other dairyman who was successful in operating it. This clearly shows that the fault was not with the machine but with the man. Some men are by nature adepts at handling machinery and animals. The man acts as a governor on an engine; he must combine and correlate the machine and the cow, and if the machine is to do its best work, it must be used with skill, patience, and sympathy for the cows.

2. The machine itself should be properly adjusted so that no discomfort will be produced. The teat cups should fit the teats,

and the pulsations of the machine should be adjusted to suit the cow. The pulsation should be slower with cows that have long teats, and cows that are hard to milk. On the other hand when cows have short teats and when they release their milk easily and rapidly, the pulsations of the machine may be more rapid. The pulsations may sometimes run as high as 80 a minute, and yet no milk be drawn, because there is not the regular sucking action necessary to draw the milk; but if proper adjustment is made, good results will be secured.

3. Cows that are hard to milk by hand are also hard to milk with a machine. Nervous, excitable cows, cows that are naturally hard to milk, and those with poorly shaped udders and teats are difficult to milk. About 75 per cent of the cows of the average herd may be successfully milked with the milking machine.

Milk cannot be extracted from the udder. If milking were only a matter of extracting milk, then any machine with sufficient power could force the milk from the udder, and the mechanical milker would invariably be successful. The adaptability of the machine in drawing milk is certainly great. But the cow is an animate thing; and hence the moods and the temperaments of cows present a much wider range than does the adaptability of the milking machine.

In using the milking machine three things must be understood relative to the production, release, and extraction of the milk. These are: (a) that the milk must be secreted, (b) that the cow must release the milk, and (c) that the milk can be extracted only after these two processes have been completed. The illustration (Fig. 142) will assist the dairyman to form a mental picture of where the milk is secreted and where it is released.

About half of the milk produced by the cow is manufactured during the process of milking. The rapidity with which the milk

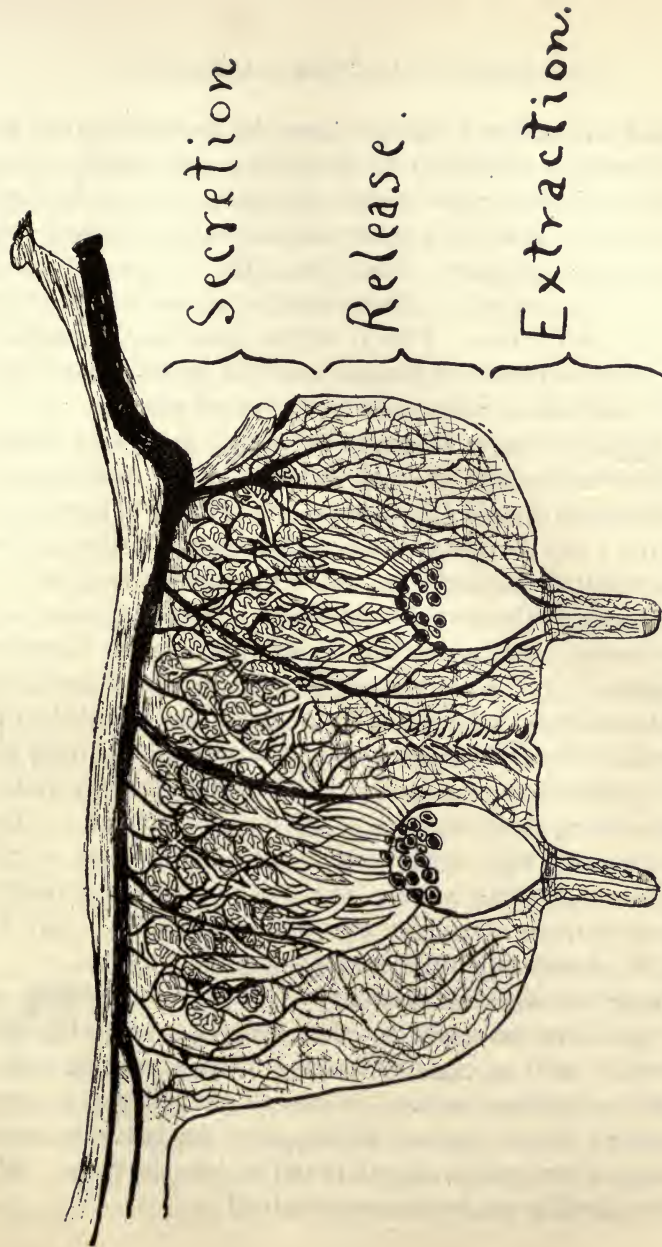


FIG. 142. — Cross section of a cow's udder showing where the milk is secreted and released and how it is extracted.

is secreted and released depends upon the temperament of the cow. Cows when frightened give down their milk slowly. Some cows naturally secrete and release their milk slowly. Not only is the teat held closed by a sphincter muscle, but also each milk duct leading to a vacuole where the milk is manufactured is held closed by a muscle. These muscles are under the voluntary control of the cow. Thus it will be seen that the release of milk is under the control of the cow, and that the milking machine must be adjusted as nearly as possible to each cow.

The following suggestions may be helpful in making milking by machine successful: (1) The udder should be well massaged before the milk cups of the machine are put on. There should be no hurry; but the cow should be well prepared for the machine. (2) The best time to begin the use of the milking machine is at the beginning of the period of lactation. However, some cows respond to the milking machine at any time during the period of lactation. (3) The cow is to be considered, and such cows should be selected and bred as are in every way adapted to the mechanical milker. The use of sires that produce the right kind of cow is important. C. Larson, of the South Dakota Station, says concerning cows adapted to the use of machines: "They should have the right temperament, give a large flow of milk, give down their milk readily and quickly, have symmetrical udders and teats of proper size and well-placed." (4) The milking machine must be followed by hand stripping.

Cleaning the milking machine. — Keeping the milking machine clean is no more difficult than keeping a separator clean. The method used in cleaning milking utensils may be used in cleaning the milking machine. First, all parts should be rinsed in lukewarm water, but not in hot water, for hot water causes the casein of the milk to coagulate and stick to the tubes. After this the following suggestions may be used:

1. If a vacuum pipe extends into the milk house, the milk cups may be dipped into a tub of lukewarm water and this water may then be pumped through the tubes. The cups may then be put into another vessel of clean rinsing-water and cleansed again in the same way. This is sufficient for the night cleaning. During the night, the parts of the machine may be put into a solution of either lime or salt.

2. After milking in the morning, the machine may be cleaned as indicated and, in addition, thoroughly washed in lukewarm water containing a washing-powder. Special brushes should be provided, and every part of the machine given a thorough scrubbing. Then every part should be rinsed in water and put for the day into lime water or salt water.

3. The two following washes have been found to be excellent and economical in the prevention of the multiplication of bacteria in milk: (1) a solution made by putting $1\frac{1}{2}$ to 2 pounds of powdered lime into about 12 gallons of clean water, (2) a solution made by putting 10 pounds of salt into 11 gallons of water. Each of these solutions should be renewed about once a week.

If these general suggestions in cleaning the milking machine are carefully observed, milk may be produced with a bacterial count lower than that which is produced under average conditions in places where cows are milked by hand.

Some of the standard milking machines on the market are, the Perfection, Hinman, Sharpless, National, Nuway, Pine Tree, Empire, Universal, Burrell-Lawrence-Kennedy, Official, and De Laval. New makes of milking machines assist in improving all mechanical milkers. - The milking machine, like a good many other things, depends upon a number of factors in order to be a success. A skillful, sympathetic operator, the right kind of cow, and a properly adjusted machine are the principal factors essential for success in the management of a milking machine.

Summary. — The proper use of machinery is important in making the farm a success. The plow, the tractor, the gasoline engine, and the milking machine have been discussed in this chapter. From other sources, such as books, bulletins, and magazines, other machines may be studied.

LABORATORY EXERCISES AND HOME PROJECTS

1. Trace the evolution of the wheat harvester.
2. Discuss the invention of the Babcock Tester and its value.
3. Classify and name 20 machines used on the farm.
4. Name 20 tools used on the farm.
5. Name 10 machines and conveniences used in the home.

CHAPTER XVIII

FARM BUILDINGS

Farm home. — The farmhouse is the home of every member of the family. It should be comfortable, convenient, and healthful. The house should be attractive and homelike in outside



Courtesy of Purdue University.

FIG. 143. — A farmstead located some distance from the public road. The house is located on a higher elevation than the other buildings and is surrounded by a large lawn with a variety of trees and shrubs. Such a home adds beauty and value to the farm and gives satisfaction to its owner.

appearances and surroundings, and within it should be cozy, and provide ease and comfort. The picture in Fig. 143 shows a fine country home and illustrates what the surroundings of a farm home may be.

The picture in Fig. 144 is suggestive of a substantial and fine farm home.

The farmhouse should be located on well-drained land, slightly higher than the site of the surrounding buildings. A gentle southeast slope is most desirable. A beautiful lawn of blue-grass and white clover with an occasional shade tree adds much to the attractiveness of the house and makes it much more home-like. Shrubbyery should be planted along the foundation of the



Courtesy of Purdue University.

FIG. 144. — A farmhouse of neat design. With a few more shrubs and plants this will make a very attractive home.

house, and some flowering plants along the borders and in front of the shrubs. Straight lines should be avoided, but clumps of shrubbery add to the picturesqueness of the farmstead.

Home conveniences are discussed in another chapter, and it will be time well spent to give that a close study, for the installment of the conveniences suggested will add much to the comfort of the home.

Purpose of farm buildings. — The purposes of other farm buildings are: (1) to reduce the feed cost; (2) to provide convenience in feeding, handling the live stock, and removing the litter; (3) to provide comfort for the animals; (4) to provide conditions conducive to health; (5) to provide conditions essential to the greatest production at the lowest cost; (6) to provide conditions so that a clean wholesome product may be produced. Every barn should be constructed for a specific purpose. A horse barn is made for horses; a dairy barn for dairy cattle, and a sheep stable for sheep. Every barn should be built in accordance with a prearranged plan, and in most cases it is desirable to plan the barn so that it can be easily enlarged.

Essentials in constructing farm buildings. — (1) *Sufficient room* is the first essential in farm buildings. Buildings should provide at least 500 cubic feet of air space for each 1000 pounds of live stock housed. A barn 50 feet by 36 feet and 7 feet high provides 12,600 cubic feet of air, and will house 20 dairy cows. The amount of room is dependent upon the kind of animal housed, and upon the ventilation of the building. (2) The second essential is *dryness*. The location of the barn on a slight elevation will help to keep it dry. If the foundation is built of concrete, coarse gravel or cinders underneath, it will help to keep the building dry. Again, gutters on the eaves to carry away the water which falls on the roof will help in keeping the

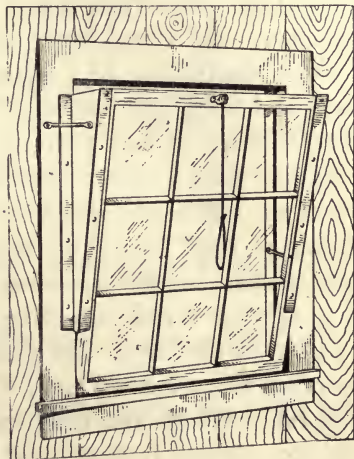


FIG. 145. — A window properly set. It is flush with the inner wall, and is so set that direct air currents cannot strike the animals.

barn dry. (3) A *proper amount of light* is also an important essential in building. From 6 to 8 square feet of glass should be provided for every 100 square feet of floor space. Windows should be set flush with the inside wall, about $4\frac{1}{2}$ feet from the floor and set in a frame as shown in the illustration (Fig. 145). (4) *Sanitation* is essential in farm buildings. This is true not only for the farmhouse, but for the other farm buildings as well. The bacteria of tuberculosis, hog cholera, and many other diseases harbor in dark and filthy places. A good dairy product cannot be produced in an unsanitary barn. The most important things conducive to sanitation are sunlight, drainage, and good floors. Sunlight is the greatest of all natural germ destroyers. Proper surface drainage and the use of tile drainage help in barn sanitation. Concrete floors help much in making the barn sanitary. (5) *Ventilation* helps in making the barn satisfactory. Proper ventilation is a means of improving and maintaining animal health and hence of lowering the cost of production. Ventilation has two purposes: to remove the foul air, which contains carbon dioxide, ammonia, and methane; and to supply fresh air, which contains an abundance of oxygen. The requirements of fresh air for animals are: horses, 70 cubic feet of air per minute; cows, 60; swine, 23; sheep, 15; and chickens, 0.5. Proper ventilation often demands the construction of a flue or flues in the barn. To determine the size of air shaft needed in a flue, Ekblaw in his book "Farm Structures" gives the following rule: Divide the total number of cubic feet of air required by 300. Thus, 12 horses and 4 cows would require

$$\begin{array}{r}
 12 \text{ times } 70 \text{ equals } 840 \\
 4 \text{ times } 60 \text{ equals } \underline{240} \\
 \text{Total} \quad \underline{1080}
 \end{array}$$

This total, 1080, divided by 300 gives 3.6 square feet, which is the cross section of air flue for 12 horses and 4 cows. There-

fore, one flue, 2 feet by 2 feet, would give ample ventilation if properly installed. But two flues, — one, one foot by two feet, and the other, one foot by one and one-half feet, — would be better.

The cut in Fig. 146 illustrates the King system of ventilation. It is recommended as being excellent for barn construction.

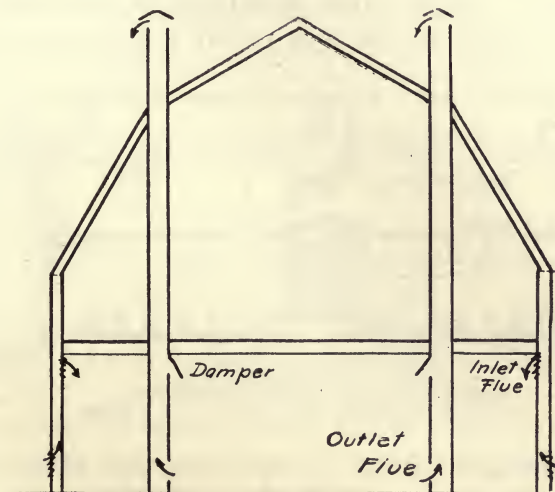


FIG. 146. — King ventilating system. Flues should be placed at the side of the barn in order that the flues may not be in the way in the barn.

The following observations relative to flues are essential:

- a. They must be air-tight.
- b. The barn must be air-tight, otherwise the flues will not work.
- c. The flues should be almost straight and smooth inside.
- d. Small flues do not work well.
- e. The flues should be capped.
- f. The intake flues should contain at least 10 per cent more cross-sectional area than a cross section of the outgoing flues.

(6) *Economy* is important in constructing farm buildings. Durability and permanence should not be sacrificed. Spending too little is as bad as spending too much. The main points to be combined in a barn are utility, strength, sanitation, and economy. Buildings should be in keeping with the surroundings, size of farm, needs, and economic production.

Dairy barns. — Dairy barns should not be connected with other barns or sheds because milk readily absorbs stable odors.

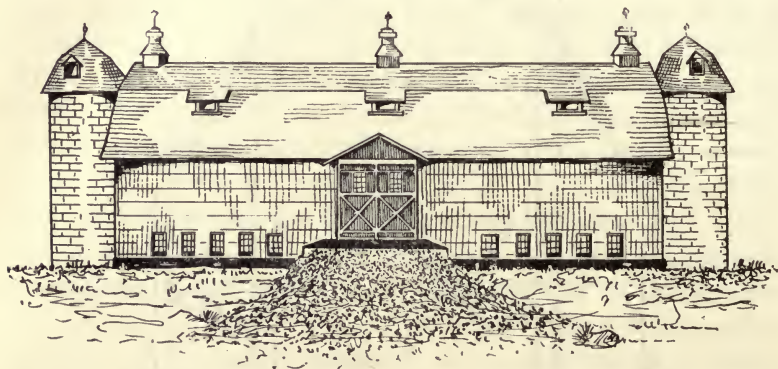


FIG. 147. — A well-designed dairy barn. The silos are placed at the side of barn instead of at the ends.

Therefore, the dairy barn should be built some 30 or 40 feet away from the other barns. Economy of construction, convenience, sufficient room, dryness, ventilation, proper amount of sunlight, sanitation, uniform temperature, and provisions for enlarging are essential in the building of a dairy barn.

Figure 147 shows the outside view of a good dairy barn.

Figure 148 shows the floor plan of a dairy barn that houses 32 cows.

The two-storied dairy barn is most commonly found. The cows are housed below, and hay is put in the second story.

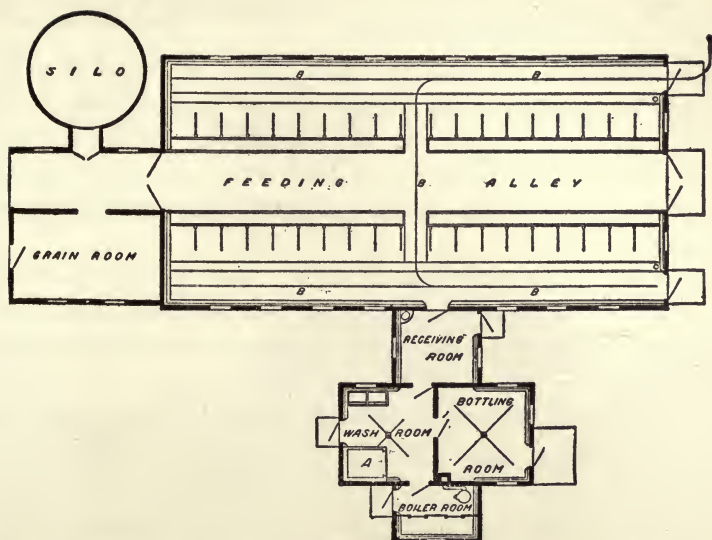


FIG. 148. — Floor plan of a barn for 32 cows. Note the receiving, bottling, washing, and boiler rooms.

A hay fork, an ensilage cutter, a litter carrier, a feed carrier, and automatic water fountains are almost indispensable conveniences in a dairy barn.

Horse barns. — These structures are similar in construction to dairy barns. There are two kinds of stalls: box stalls and standing or slip stalls. Box stalls should be 10 by 12 feet. Every barn should have at least one box stall. Standing stalls should be 5 feet wide, and the total length should be 14 feet, divided as follows: 2 feet for the manger; 7 feet for the length of the horse stand; and 5 feet for the width of the passageway. The gutter which carries the liquid manure should be 4 inches deep and 16 inches wide. This gutter may be uncovered, or it may be covered with cast iron plates with holes in them.

Various kinds of partitions are used to separate horses in

their stalls. Solid partitions are not recommended, because they prevent the circulation of the air.

The interior of the stalls and barn should be as free from projections as possible. The harness should be hung high enough so that it will never obstruct the passageway for the caretaker or the horse. The manger and feed boxes should be so built that the chances for the horse to injure itself are reduced to a minimum.

Floors of horse barns are made of dirt, concrete, wooden blocks, or boards. Concrete floors seem to meet all the demands best. The floors of the individual stalls should be covered with wooden flooring.

The amount of air space per horse should be about 1600 cubic feet. Each horse should be provided with 15,000 cubic feet of air every hour. Therefore, if the cubical dimensions allowed each horse are 1600 cubic feet, the air has to be changed $9\frac{1}{2}$ times each hour. This may be secured by ventilation.

Light is an important essential in a horse barn. Therefore, plenty of windows should be provided and placed so that the sunshine may come into each stall daily. This means that the barn must be set north and south.

Horse stables should be kept cooler than cow stables. Horses work regularly in the open air, and if they are kept in warm stables they do not stand the daily outdoor work so well.

Barns are seldom built to shelter horses alone. Sometimes beef cattle are housed on one side of the barn. While this is a common practice, yet it is not to be recommended. Farm machinery is often put into the general barn. This practice is fairly satisfactory if the machinery is inclosed by a dust-proof wall. On some farms the machinery becomes the roosting shed for the poultry. This is a very bad practice, — bad both for the fowls and for the machinery.

Houses for hogs. — There are ten essential points to consider in the construction of a hog house: (1) The first essential is *warmth*. Hogs are not protected against cold as well as horses and cattle and hence reasonably warm shelters are required. This is true both for pork production and for the production



FIG. 149. — A fine type of hog house, good for every month of the year. Compare the window and door arrangement of this house with that shown in Fig. 150.

of early spring pigs. (2) *Dryness* is essential to economic hog production. Hogs will not do well in damp or wet quarters. The floor should be well drained and the walls and the roof should be water-tight. (3) *Ventilation* is also essential to pork production. Fresh air, due to good ventilation, but not drafts, aids in securing the best and cheapest gains. (4) *Sanitation* helps in preventing sickness among hogs. Dusty quarters cause cough-

ing and sneezing, and predispose the hogs to pneumonia. The house should be so built that it can be easily cleaned, and it should be cleaned regularly. The hog's nose is close to the ground, and hence it must breathe in the dusty air which is likely to carry germs into its lungs. Cleanliness is an absolute essential to a good hog house. (5) Admission of *sunlight* into the hog house is very helpful in keeping the house clean and sanitary. Every house should be so built that the morning sunshine may reach the entire floor and remain there as long as possible. (6) *Convenience* is an essential in hog-house construction. The above house can be easily cleaned and easily bedded because the sides and ends are fastened by hinges and can be easily lifted up. The house is movable and that makes it convenient. (7) *Sufficient room* is an important consideration in hog houses. A house 8 feet by 10 feet makes a good house for a sow and a litter of pigs. (8) The *initial cost* should not be too high, for if the cost is too high, it is more difficult to make it pay. (9) *Shade* is another essential in hog-house construction. Hogs suffer as much from extreme heat as from extreme cold. Often hogs die from heat, and the protection of hogs against heat in the lot or in transit is only humane treatment. (10) *Durability* is also to be considered in hog-house construction. Material that is fairly permanent should be used, and the entire house should be so built that little repair will be needed.

Hog houses are of two types, — the small portable house and the large stationary house. Portable houses are usually 8 by 10 feet. They may be pulled from place to place by a team of horses.

The large stationary house is about 28 feet wide and any desired length. An 8-foot alley runs lengthwise through the middle of the building. On each end of the alley are pens 10 feet deep. The windows are so placed that the house gets a maximum amount of sunshine at the proper place.

Every large stationary hog house should have a place for the storage of feed, and a platform scale arranged so that the hogs and feed can be easily weighed.

Sheep barns and sheds. — Sheep barns should provide three



FIG. 150. — A good, serviceable hog house. Note location of the windows. The sides and ends of the house are hung on hinges and may be raised as shown in the picture. This makes the house a comfortable place for the hogs in summer.

conditions. They should be (1) dry, (2) well ventilated, and (3) roomy.

1. *Dryness* is very important in sheep-barn construction because the heavy coat of wool, when it becomes wet, requires a week or ten days to dry out. This keeps the sheep constantly chilled, and consequently disease makes its appearance. Gains cannot be made if the sheep are not comfortable. A well-packed earth floor, slightly elevated, makes a very good floor, but it

must be so made that it is dry at all times. From 6 to 8 square feet of window space for each 100 square feet of floor space should be provided, and the windows should be so placed that the entire floor receives sunshine sometime during the day. These, combined with proper ventilation, will provide the dryness which is essential in a sheep barn. The best wool cannot be produced if sheep are left in the rain.

2. Proper *ventilation* is another requisite of a sheep barn. Wild sheep lived on the mountain tops where the air is fresh

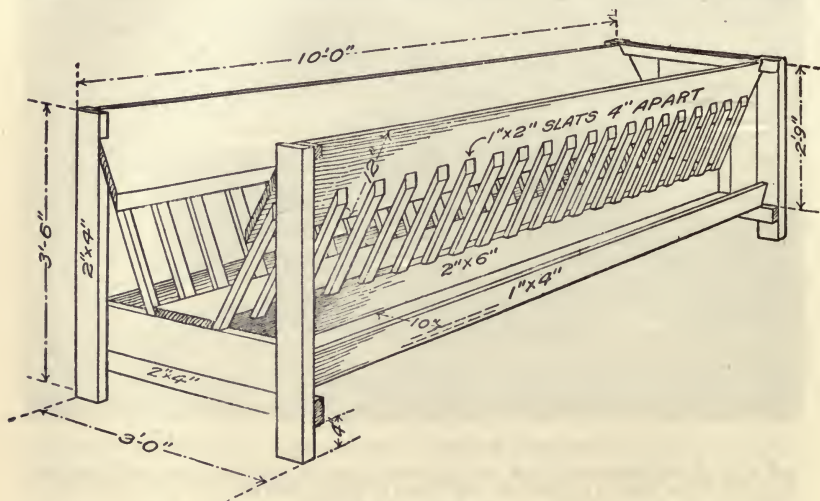


FIG. 151. — A convenient feed rack for sheep. Both hay and grain can be fed in this rack.

and pure, and hence sheep like fresh pure air. Drafts should be avoided. The windows in the barn should be left open the entire year, and doors should be made so that the upper half of the door may be left open. This will provide the necessary ventilation.

3. Sufficient *room* is the third essential of a sheep barn. From 8 to 10 square feet of floor space should be provided for each sheep. Maternity stalls should be 10 feet by 12 feet.

A good type of sheep barn has an open shed at one side which provides the finest shelter from rain during the greater part of the year.

Figure 151 shows a combination hay and grain rack for sheep.

Sheep barns are either simple sheds with no storage room, or high barns in which feeds may be stored, or a combination of the two. The kind to be built must be determined by the farmer himself. The final factors are: the cost of construction, convenience, and the economic output of mutton and wool.

Summary. — Barns are an important factor in the economic production of farm animals and their products. For this reason every essential in barn construction should be employed. Comfort to the animal spells everything in barn construction, and if comfort is provided it is certain that the factors essential in barn construction have been used. Convenience to the attendant must be kept in mind, and the cost of construction should be kept within reasonable limits. Horse barns, cattle barns, hog houses, and sheep stables are all slightly different in their plan, size, and essentials of construction; and therefore each should be built for its specific purpose and according to a pre-arranged plan. The farmer should determine what he needs and build accordingly.

LABORATORY EXERCISES AND HOME PROJECTS

1. Go to some well-planned barn, study it as to dimensions, size of stalls, location of feed bins, and convenience. Draw floor plan according to scale and also draw the end view of the barn.
2. Draw floor plan of your house. Re-plan the same so that it will be more convenient, more comfortable, and not much more expensive in construction.
3. Select and read carefully a bulletin which relates to some farm building. Report on: (1) dimensions, (2) size of stalls, (3) size and placement of windows, (4) provision for ventilation, and (5) convenience. (If possible, each student should use a different bulletin for this exercise.)

4. Score a farm building according to following score card:

1. Room	10
2. Convenience	10
3. Dryness	10
4. Ventilation	10
5. Sunlight	10
6. Economy of construction	10
7. Protection against heat and cold	10
8. Sanitation	10
9. Interior fixtures	10
10. Repair	<u>10</u>
Total	100

CHAPTER XIX

BOYS' AND GIRLS' CLUB WORK

Scope and origin. — Boys' and Girls' Clubs are organizations of young people between ten and eighteen years of age inclusive, having as an aim the study of some problem or project closely related to the activities of the home and the farm. The Smith-Lever Act, under which club work is conducted, provides for "giving of instruction and practical demonstrations in agriculture and home economics."

Club work had its origin in the South under the leadership of Seaman A. Knapp. He conceived the idea that agriculture and home economics could be taught most effectively by means of demonstrations carried on by boys and girls. In the North the work was first developed in Iowa under the leadership of O. H. Benson and Jessie Field, two county school superintendents.

Purposes. — The aims of club work are to enlist boys and girls in profitable and interesting activities, to teach young people to form habits of observation, to develop leadership and coöperation by taking advantage of the *gang spirit* of boys and the *sets* of girls and direct them into useful channels, to inspire in each member the right attitude toward honest toil, to encourage members through organization and proper leadership to take initiative and to attack problems, to follow persistently to a successful completion a few well-planned club projects, to offer to leaders and parents an effective incentive for close coöperation in making the school a center for better social conditions.

Clubs have been organized in the United States along the following lines: sewing, baking, canning, hot school lunch, gardening, poultry, corn growing, pig, calf, sheep, grain judging, and stock judging.

Essentials for success. — Much of the success of club work depends upon the organization. There are decided advantages in a county organization. Whether the county leader is the county agent or the superintendent of schools or some other person, there should be a county plan and program. This plan should decide upon the lines of work to be undertaken, when the work should begin, and when it should close. The county program should provide for meetings of local leaders, which in some cases are held as township meetings and in others as county meetings. The aim of these conferences is to consider the progress of the work, the difficulties that have arisen, and to discuss matters relating to the further progress of the projects. The program should also provide for club visits and for local and county exhibits, contests, and demonstrations.

Before a club is organized a community should understand what club work means. Much has been written and said about this movement; still there are many misconceptions. Some think it is only a preparation for a contest and others think it is a kind of reading course. While both of these are essential to club work, still neither is the end.

The aim of the club should be clearly understood by boys, girls, and their parents before an organization is effected. It is best to present this matter at a meeting of boys, girls, and parents called especially for this purpose.

Plan of organization. — The formation of a club and the line of work to be done having been decided upon, the next step is the organization. This deserves careful consideration. Club work should not be presented as something easy — a picnic

affair — but should challenge members to put forth their best efforts. It is a good plan to have each member sign a pledge similar to the following: "I hereby agree to abide by the rules of the club, to carry out my project, to keep a record, with a story of my work, and to take part in the exhibit should one be held." This should be countersigned by the parent.

After a club is organized, the enrollment is sent either to the county leader or direct to the State office, depending upon the county plan. When the enrollment reaches the State office, three copies are made: one is sent to the local leader, one to the county leader, and the other is kept at the State office. After the enrollment is received at the State office, topics of instruction are sent either direct to the local leader or to the county leader who will send them to the local leader.

Standard club. — Whenever possible a club should organize as a standard club. The requirements are as follows:

1. A membership of at least five working on the same project.
 2. A local leader having charge from the organization until the final reports are made.
 3. Club officers consisting of at least a president and secretary.
 4. A definite program of club work. This should provide for at least six meetings at which the club officers preside.
- These are the four requirements. Others which should be met if possible are the following:
5. Hold a club exhibit.
 6. Organize a demonstration team to give at least one public demonstration.
 7. At least 60 per cent of the members should complete the work and make final reports.
 8. Organize a judging team.
 9. Give a club program for the benefit of the public.

10. When the first four requirements are met a club is entitled to a standard charter. When all the requirements are met a club is entitled to a national seal of achievement.

Sometimes it may not be possible for a club to organize with five members; however, it is well to make the standard club the goal if possible. This gives a measurement by which the work of a club may be compared in some degree with that of other clubs.

There should not be more than one standard charter in a community. It should bear the name of the community or club organization, and the names of leaders and projects should be added from year to year as the work is completed. Great care should be exercised in choosing club officers. The president should have some executive ability, and the secretary should be careful as to details and be able to write well.

Constitution and by-laws. — Many clubs desire to adopt a constitution and by-laws. These should be short and simple so as to be easily understood and followed. The sample given below was formulated with this idea in mind. It should be changed to meet local conditions.

CONSTITUTION AND BY-LAWS

CONSTITUTION

ARTICLE I. — This club shall be known as the
..... Club of District, No.
..... County, Missouri.

ARTICLE II. — Members of this club must be between ten and eighteen years of age inclusive.

ARTICLE III. — The aim of this club is to follow a definite line of work in agriculture or home economics, to make practical application of the things studied, to make careful observations and records of the work done, to keep an account of the expenses and receipts in connection with the work, and to make a comprehensive report of the same in a well written story.

ARTICLE IV. — The officers of this club shall be a president and secretary chosen from the members.

ARTICLE V. — The election of officers shall be held at the time of the organization of the club and each year thereafter at the time of the reorganization of the club.

ARTICLE VI. — The leader shall have personal supervision of all club work.

ARTICLE VII. — This constitution may be changed at any meeting by a two-thirds vote.

BY-LAWS

1. The president shall preside at all meetings and shall assist in every way to make the club work a success.

2. The secretary shall keep a record of the names and addresses of all club members, also a record of the proceedings of each meeting and shall assist in every way to make the club work a success.

3. A local leader shall assist the president and secretary in their official duties, conduct the discussions, give out topics of instruction, blank reports, and make suggestions for further work.

4. It shall be the duty of the members to attend local and county meetings and to take part in the same.

5. The club shall hold monthly meetings on such dates and at such places as may be set by the local leader. The officers shall have power to call extra meetings at any time.

6. At the monthly meetings each member must be ready to give a written or verbal report on what has been done since the last meeting.

7. In connection with the monthly meetings the local club leader should arrange for special talks, lectures, or demonstrations along the line of work being followed.

8. These by-laws may be changed at any meeting by a majority vote.

It should be clearly understood that the purpose of the constitution and by-laws is to give a simple method of club organization and procedure.

Local leaders who are teachers will have little difficulty in arranging time for club work; usually one period a week is used for discussing club work. In case the work relates to something that must be done at home, as scoring live stock or selecting seed corn, members should report on what was done. Compare

reports and discuss them. Give attention to any records that should be made. Take up the next topic in the work ; see that members understand what is to be done. Question much on what was done, how it was done, and why it was done.

Parliamentary practice in club work.—If a club aims to become a standard club, one of the requirements is that there shall be six club meetings at which the club officers preside. This requirement is made in order that club members may be given practice in conducting public meetings. This is a need that is felt in many communities and no one will question the practical benefits that should follow. Only a few parliamentary rules should be considered. These briefly stated are the following: (1) Calling a meeting to order. (2) Roll call and response. (3) Reading and adopting minutes. (4) Making and seconding motions. (5) Voting, by *aye* and *no*, by raising hands, by standing, by ballot. (6) Declaring motions carried or lost. With a thorough understanding of these few simple rules, a club will be able to conduct a public meeting with some credit.

The club meetings at which the officers preside may be held during school hours or at the close of school. A club that is not a school club should hold these meetings at a time and place that is most convenient for all concerned.

Club program.—Inquiries are frequently made concerning the nature of the program which should be carried out at club meetings. These will vary according to the club project, the age of the members, the season of the year, and other circumstances. Only general suggestions can be given. Suppose it is a poultry club that has been working two months. The program might probably be arranged as follows :

1. Call to order by President
2. Roll call by Secretary. Response by members, giving some fact relating to poultry

3. Reading and approving minutes
4. Club song
5. Repeat club motto
6. Club pledge given in unison
7. Story on the different classes of chickens and their origin and characteristics by a member
8. Story — (What I have done in my club work, by a member)
9. Club song
10. New and unfinished business
11. Talk by the leader
12. Adjournment

In case the club meeting is for the public, the program should be somewhat more elaborate. Leaders, however, should be careful about arranging for a public meeting before the club has had sufficient practice to carry out a program. A failure at the first public meeting is discouraging.

Exhibits. — Every club should plan for an exhibit. Do not hesitate because the club is small. If two or three take an interest,



FIG. 152. — A school exhibit of girls' work.

it is a beginning. Club members should not be discouraged because their products are poor, provided they have made a good effort. Poor seed, unfavorable weather, and other circumstances

may have been obstacles in the way ; however, the exhibit should be made. Show the best you have and let the story of your work tell about the difficulties which have been encountered. One of the best club stories ever written told about a boy's loss in growing melons.

Exhibits afford an opportunity to make comparisons, to see the best produced, to study defects, and to set standards. Besides the regular club products which are shown, very interesting exhibits can be made of club charts, posters, and notebooks. Club charts are made of heavy paper, usually about 24×36 inches, and relate to some project, as baking or gardening. They may give an outline of the topics discussed, the result of a community survey, or make a graphic illustration of some important matter. Posters should be 18×24 inches. Do not put too much on a poster, but let each one emphasize a particular point in club work. Notebooks should contain a record of the club organization, history of the club, an outline of the subjects considered, field trips, surveys made, special club events, exhibits, contests, and other activities.

Prizes and contests. — Prizes have their place in club work, but should not be stressed too much. It is poor policy to urge club members to do club work primarily to win a prize. Local communities as a rule are generous towards requests for prizes, provided the matter is not overdone. A club member should feel amply rewarded, if he has the best exhibit at a local or county show. Prizes should have some relation to the kind of exhibit made. A hand spray is much more appropriate for a premium in a garden exhibit than a necktie.

In connection with exhibits some kinds of contests are usually held. If an exhibit of poultry is made, most often the contest is based on judging poultry ; if the exhibit is corn, a corn-judging contest is held. This refers to contests in club products. There

are club contests in games, stunts, and other competitions which are always an interesting feature in a club-day event.

A club record contest may be made very helpful in a county program. The aim is to encourage good work and to award a banner or pennant, to be kept one year, to the club making the highest record in the county according to the following score:

POINTS

1. Total enrollment	15
2. Number of meetings held (12 perfect score)	15
3. Highest average attendance at regular meetings	20
4. Highest percentage of members submitting complete reports	30
5. Highest percentage of members making exhibits	20

Explanation: If the highest enrollment is 30, the score on this point is 15. If the second highest enrollment is 24, the score would be 80 per cent of 15, which is 12.



FIG. 153. — Mr. Joseph Cook, practical farmer, showing fine points of his Holstein to the members of his class.

Meaning of demonstration. — The term *demonstration* has two meanings. The first implies the work of a whole project, as corn growing, beginning with the selection of the seed and

closing with the harvesting of the crop and making final reports. The second meaning refers to some particular factor in the project, as testing seed corn or determining the shelling percentage.

Demonstrations are given by leaders or some capable person for the purpose of teaching an important operation. All the members of a club or of several clubs may be brought together for this purpose. The demonstration may be any of the following or others: How to spray, how to select seed corn, how to disinfect seed potatoes, how to cull poultry flocks, how to select clothing, how to judge bread, how to keep club records.

When demonstrations are given by club teams or by a single member, the aim is to show the knowledge and skill acquired by the members and also to show some important process in club work.

Method of demonstration. — In giving a demonstration, begin with some short, simple process. Let the demonstration develop naturally from the actual work done. A talk or recitation should not be considered a demonstration. Remember that a demonstration deals with material things and aims to teach a process. In order to insure success, see that all needed materials are at hand, that the subject matter is understood, and then the demonstration will proceed naturally.

Club stories should be required in all projects. If records are properly kept, the story will not be a big task. This phase of the work, like demonstrations, should be developed. After making a field trip, after a demonstration or some other interesting event, members should tell about it orally and then put it in written form. Keep attention fixed on the final story. It should mention every important process, every interesting event, and give the final results and conclusions that have been reached. The language should be plain, simple, and correct. The writing should be such that it can be easily read. A club member should

take pride in his story because it is a narration of his own efforts. The educational value of this phase of the work will be granted without any question.

Social side of club work. — Club leaders and club workers should not lose sight of recreational activities. If club work is to play any part in the solution of the country life problem, then club members must be students of agriculture and home economics, and they must also interest themselves in those problems that make for a happier, more contented, and more satisfying social life.

The charge has been made that young people in the country do not play, that social life is dull and static. There are many reasons for this conclusion; however, if conditions are ever improved, the movement must be begun with boys and girls. They must be encouraged to take the initiative and learn to be self-dependent. A club organization is a good avenue through which to work. Boys and girls should be encouraged not only to excel in the matter of production, — to produce the best and at the least expense possible, but also to become leaders in plays, games, and other wholesome amusements. Club games should be adapted to both sexes; they should require the smallest amount of equipment and be such that a small number may play as well as a large number.

Club singing. — Singing will do much to enliven club work. Community singing needs to be cultivated. Do not hesitate because there is no instrument at hand, nor a trained leader present. Begin with simple songs and keep trying. There are many club songs that young people like to sing. Club leaders should arrange for some games, songs, and other recreations at as many club meetings as possible.

Project methods. — Club leaders should make out a program of work which should give consideration to the things to be done,

when and how they should be done, preparations to be made in advance, records to be kept and reports to be made. From the very beginning the leader should see to the close of the work and plan accordingly. This will be illustrated by using one or two projects.

a. *Corn growing clubs.* The aim is to demonstrate the most approved method of producing corn at the least expense. The topics will include the following:

1. Selecting a variety suited to the locality
2. Testing seed
3. Fertilizers
4. Preparing the seed bed and planting
5. Injurious insects
6. Cultivation
7. Field selection of seed
8. Harvesting and measuring yield according to directions
9. Keeping a record of expenses
10. Make a local exhibit of ten ears
11. Make out final reports
12. Write a story of the work

If a club is organized early in the year, and if it is a school club, all these topics may be studied before the crop season begins. Every detail may be explained, even to the making of the final reports. There is an advantage in this plan because members will understand from the beginning what things are required.

Club meetings may be held at a home, schoolhouse, church, or in the open, but the project work must be done at home. When a meeting is held during the crop season, the first thing that should be considered is the work that has been done. Let members report, giving their experiences, and comparing notes. This is one of the most useful factors of club work. After this is done, give consideration to the next topic or topics. Club

members should have a clear understanding of the next step. Careful records should be made of all that is done. Discuss these records as the work proceeds. If this is done, the final reports and story will be easy matters.



FIG. 154. — A large hatch of chicks

b. Poultry clubs. The aim of this project is to teach club members how to make poultry raising more profitable. The

first year's work is a hatching project. Members are required to do the following:

1. Make four settings of eggs (60) from pure bred flocks
2. Study the best method of feeding and handling young chicks
3. Make brood coops, feed hoppers, and watering troughs
4. Study the control of lice and mites
5. Poultry disease and sanitation
6. Make a local exhibit of a cockerel and pullet
7. Cull the home flock
8. Keep a record of work done and all expenses
9. Make final reports and write story of the work

Club members are encouraged to improve the quality of poultry, increase the size of the flocks, cull out the slackers, learn something about classes and breeds of chickens, and make a poultry survey of the community. In case the club is organized in a school, the different topics can be considered to good advantage during school hours, but the work must be done at the homes. If a club has no connection with a school, the meetings will be held at some place most convenient for the members. The plan of work should be similar to that suggested for corn clubs.

Poultry club members will be greatly benefited by visiting each other, inspecting the plans as carried out, and making comparisons. Sometimes these visits are arranged for the members to go in a body from house to house. When this is done, the member visited should explain his plans and others should ask questions. Do not prolong visits beyond the point where interest lags.

The method of conducting other lines of club work will be similar to those of corn clubs and poultry clubs. The leader and club members should always make a general survey of the club project, make a note of the different topics to be considered,

when each process is to be done, and close with the final reports. This will enable the club to make out its program and to work to the completion of it.

Relation of club to school. — The question is often asked, What is the relation of club work to the country schools? Club work is supported by funds derived from the National and State Governments and is under the direction of the Agricultural Extension Service. Public schools are supported by state and local taxes and are under the direction of a board of directors.



FIG. 155. — A litter of Chester white pigs.

The aim of club work, as stated in the opening paragraph, is to make a study of some problem or project closely related to the farm and the home, and to put into practical operation this knowledge gained. It is hardly conceivable that a project could be completed without club members having acquired some valuable knowledge.

A common definition of the function of the school is to prepare boys and girls for useful citizenship. This is open to criticism, but it will be accepted for the present discussion. If the school

attempts to measure up to this responsibility, it must give consideration to community needs and community problems, and more attention must be given to teaching pupils in terms of their environment. This will certainly be a step towards preparing boys and girls for useful citizenship.

What are the relations of club work to this educational program? The club projects are based on the activities of the home and the farm; therefore, are closely related to the environment of the members. Club work aims to produce corn, pork, poultry, and other products, at the least expense; therefore it is related to community needs. The desire to raise the best vegetables, can the nicest fruit, or bake the best bread furnishes a motive for study and effort in club work. The ambition of a club to excel as an organization strengthens the spirit of coöperation which is so much needed in rural communities. Club work deals with familiar things, practical things, concrete objects, thereby following some well-established principles of pedagogy. Nothing has yet been discovered that brings about a closer relationship between the school and the home than club work; thus is achieved another desirable aim in education.

Club records, stories, notebooks, posters, and charts are important educational factors, and, when used in connection with the regular school program, they can be correlated to great advantage. There is naturally a close relation between club work and the school. It is possible to use this relation very much to the advantage of boys and girls and the community as a whole.

The four-leaf clover — the symbol of club workers. — Each leaf contains the letter H, which stands for the head, the hands, the heart, and the health. They are further explained as follows: Train the head to think, plan, and reason; by attending school, being a club member, reading books, papers

and magazines. Train the hands to be useful, helpful, and skillful; by helping at home, in the club, in the games, and doing a good turn daily. Train the heart to be kind, true, and sympathetic; by self-denial, and service for others. Train the health to resist disease, enjoy life, and make for efficiency; by deep breathing, moderate eating, clean teeth, clean body, early to bed, early to rise, sleep with windows open.

THE CLUB PLEDGE

As a true club member, I pledge my head to clearer thinking, my heart to greater loyalty, my hands to larger service, and my health to better living, for my club, my community, and my country.

THE CLUB CREED

I believe in Boys' and Girls' Club Work for the opportunity it gives me to become a useful citizen.

I believe in the training of my head for the power it will give me to think and plan and reason.

I believe in the training of my heart for the nobleness it will give me to be kind, sympathetic, and true.

I believe in the training of my hands for the dignity it will give me to be helpful, skillful, and useful.

I believe in the training of my health for the strength it will give me to enjoy life, to resist disease, and make for efficiency.

I believe in the great trinity of club work: the School, the Home, and Achievement.

I believe in my country, in the State of Missouri, and my responsibility or their development.

In all those things I believe I am willing to dedicate my service for their fulfillment.

THE COUNTRY BOY'S CREED

I believe the country, which God made, is more beautiful than the city, which man made; that life out of doors and in touch with the earth is the natural life of man. I believe that work is work wherever I find it, but that work with nature is more inspiring than work with the most intricate machinery. I believe that the dignity of labor depends, not on what you do,

but on how you do it ; that opportunity comes to a boy on the farm as often as to a boy of the city ; that life is longer, freer and happier on the farm than in the town ; that my success depends, not on my location, but on myself ; not upon my dreams, but upon what I actually do ; not upon my luck, but upon my pluck. I believe in working when you work, playing when you play, and in giving and demanding a square deal in every act of life.

EDWIN OSGOOD GROVER.

CHAPTER XX

CHOOSING A FARM

FARMS are purchased for economic purposes and for the purpose of making homes. Both of these points are so important in the choice of a farm that Cato's advice given two thousand years ago may still be followed: "When you have decided to purchase a farm, be careful not to buy rashly; do not spare your visits, and be not content with a single tour of inspection. The more you go, the more will the place please you if it is worth your attention. Give heed to the appearance of the neighborhood — a flourishing country should show its prosperity. When you go in look about, so that, when need be, you can find your way out." ¹

The economic aspect, in purchasing a farm, is important. The farm should make a satisfactory home for every member of the family. The factors bearing upon these two points will be discussed in the following paragraphs. This brief treatise is general, and the statements made will not be without exceptions in many localities of the United States.

Economic aspects in choosing a farm. — *Soil.* The kind, lay, and fertility of the soil are of greatest importance. The texture, structure, amount of organic matter, and the depth of the soil are important things to consider. Free use of a post-hole digger, or soil auger, on every five acres of the farm, aids in

Note to the Teacher: Work out data suggested at close of chapter.

¹ Warren; "Farm Management."

this study. A depth of from 3 to 5 feet of the soil should be carefully examined. (Fig. 156.) A soil composed of about equal parts of clay and sand makes a good foundation. This with an additional supply of organic matter gives a desirable soil. Examining the soil and the subsoil with the hand and washing some of the soil to find its sand content help in gaining a proper estimate of its real productive value.



FIG. 156. — A soil auger made by welding a $\frac{3}{8}$ -inch gas pipe to a $1\frac{1}{4}$ -inch wood auger. An excellent tool in its proper use in estimating the value of land.

Farm improvements. Warren says upon this point: "The site of the farm, with respect to the fields, the number and kind of buildings, fences, and orchard, will of course be carefully inspected. Chief attention should be given to the roofs, foundations, frames of buildings, and least attention to paint. The arrangement for convenience in work is of importance.

"But one should be careful not to buy a farm merely for its buildings. Many Western men buying Eastern farms are buying buildings. The farms look cheap, because the buildings are worth more than the price asked. But there is no profit from buildings. In very many cases the farms never did pay. The early settler made his little income by lumbering, and used a generous amount of lumber for buildings. The lumber is gone: the farms have such poor soils that they do not pay for working. Of course this does not apply to the thousands of Eastern farms that have rich soils, but good soils are not given away with a present thrown in."¹

Hunt states, "From an economic point of view it is possible that for general farming it is not wise to invest more than one-fourth the aggregate value of the farm in buildings of all kinds."

¹ Warren; "Farm Management."

Many farms have more capital invested in buildings than can be justified upon an economic basis. Farms with such necessary improvements in the way of buildings, fences, orchards, etc., all in good repair, can generally be purchased more cheaply than can an equal amount of land, plus the cost of putting on an equal amount of improvements. However, in regard to this matter there is no general rule to which no exceptions can be laid down.

Where a farm is supplied with buildings, it should be observed whether or not the buildings conform with the type of farming for which the farm is to be purchased. A chicken house is usually a poor corn bin or sheep stable. If buildings must be rebuilt, the cost of doing so must be carefully estimated before a farm is purchased.

Markets. Good markets are important to the successful operation of a farm. Dairy and truck farms should be within three or four miles of a railroad station, which is in direct line to a good market. Grain farms may be a little farther away from the market, and where grains are fed to livestock the farm may be still a little farther from the station. Dairying and vegetable gardening are hazardous occupations if the farms are far away from the trunk line of a railroad. Direct transportation facilities are important in choosing a farm.

Roads. Kind of roads and methods of transportation affect materially the value of a farm. Good, level roads that are open all the year increase farm values wonderfully. Transporting a pound of material one mile on unpaved roads may require as much energy and cost as much as transporting ten pounds the same distance over a paved road. In other words, transportation over ten miles of good level roads may not cost any more than transporting the same goods over one mile of unpaved roads. Good roads bring the market nearer.

Coöperation. Another factor that may well be considered is the spirit of coöperation in a locality. Coöperation in purchasing things needed about the farm and in selling farm products is very desirable in any community. It is generally true that \$10 will buy more than ten times as much as will \$1. Coöperative marketing is often very convenient and economical. One man may often haul the milk sold by ten or more dairymen living along one route. This saves time and labor. Machinery may be owned coöperatively. Farmers may coöperate to improve markets. Schools, churches, a library, and other valuable institutions may be had in a community which coöperates.

Size of farms. One of the important factors in the selection of a farm is its size. The type of farming to be practiced will influence the amount of land needed. For truck farming a few acres may be sufficient. A larger farm is needed for grain farming, and in stock production even larger farms may be more economical. The labor, the farm implements, and the number of horses needed to do the work on 160 acres is not much greater than that needed to farm 80 acres. Very small farms mean unemployment for both man and horse. The old saying, "Three acres and a cow" or "Three acres and liberty," usually means unemployment and a small income. While no general rule can be stated as to the relation of size of farms to profits, it may well be borne in mind that farms large enough to use labor-saving machinery and employ constantly horse and man labor are essential to success in farming. The size of a farm must be considered in choosing a farm.

Choosing a farm for a home. — The healthfulness, the neighborhood, the privileges of the church, school, and community organizations are very important in the choice of a farm, — even as important as are the factors influencing the economic aspects

of a farm. Suitable social surroundings concern parents more than the production of a crop. Providing such conditions in the rural communities that the boy and girl of the country are satisfied to live in the country, is a problem yet to be solved in most rural communities. The two important factors in causing the boy and the girl to remain on the farm are:

1. An economic income from the farm so that the conveniences of life may be had at least to a comfortable degree.

2. The building of such a home and community that the social wants of the family are supplied. The first of these points has been discussed in the above paragraphs. Some of the factors influencing the second will be mentioned in the following sections.

Healthfulness. To choose a farm that does not provide healthful conditions is to invite failure at once. The healthfulness of a home is all-important. The house should be located on an elevated, dry, well-drained spot. Low, swampy places are conducive to malaria, typhoid fever, and rheumatism. If an entire locality is unhealthful, it will require community coöperation to remove the cause and improve the conditions. In the choice of a farm its conditions for maintaining and promoting healthfulness must be carefully considered.

Neighborhood. The moral standards, the progressiveness, the community spirit, and neighborliness are of vast importance in choosing a farm. Good roads, schools, churches, homes, and farm improvements are indications of a desirable community. A high grade of stock and farms that are well planned and cultivated characterize a good farmer, a good stockman, a good



FIG. 157. — A landmark of learning. Better school buildings are being built to-day.

homemaker, and a desirable citizen and neighbor. Farmers and farmers' children are compelled to mingle with their neighbors in coöperative farm work, in church, in school, and in other organizations, and it is important that neighborliness and social kindness and a brotherly spirit prevail.



FIG. 158. — A school garden, an important factor in economic living in country or city.

Schools. No one would purchase a farm in a locality where there are no schools. Schools enhance the value of lands and are a great factor in the uplift of any community. To be able to locate near a town, village, or consolidated school may be worth from \$5 to \$10 an acre of land purchased. The consolidated schools of Iowa, Ohio, Missouri, Minnesota, North and South Dakota, Illinois, Wisconsin, and Indiana are very valuable to the communities in which they are located. Com-

munity transportation of children to schools is successful (Fig. 159) and fairly economical in many localities.

Churches. The opportunities for religious services are also important. The physical, intellectual, social, and religious development and training of children and adults are all essential. Often the schoolhouse is the center of all the social and religious functions of a community. The schoolhouse is public property and should be open for use to any gathering which has for its



FIG. 159. — Conveying pupils to school. During winter months closed wagons are used.

purpose the betterment of the community. The country church adds values which cannot be measured by money. In some instances it may be feasible in the construction of schoolhouses to add a room in which the community may have meetings of various kinds, — religious, educational, and social. Such a meeting place will help solve rural problems.

The "Federated Church" represents a neighborly, brotherly, spiritually united community. The federated church is a landmark in the evolution of community development. Such a locality is a good place for the establishment of a home.

Social gatherings. Literary clubs, debating societies, spelling matches, farmers' organizations, girls' and boys' clubs are worth much to any community; they foster community coöperation and help the community to get what it wants.

Summary. — In choosing a farm the economic and home-making aspects are important. The fertility and productiveness of the soil, the farm improvements, the markets, and the size of the farm are conditions that affect the choice of a farm from an economic standpoint. The healthfulness, good neighbors, school, church, and social opportunities and facilities affect the choice of a farm from a homemaking standpoint. The choice of a farm may bring either success or failure.

LABORATORY EXERCISES AND HOME PROJECTS

1. Have pupils ascertain from several farmers the value of their farm buildings. The value of separate buildings should be itemized. At the same time the value of the land should be asked for. The buildings represent what per cent of the total value of the land and buildings? Discuss the value of different buildings in their connection with the type of farming practiced.

2. Have each pupil determine the distance traveled to and from market upon the basis of the distance they live from market, if they go to market daily. Find the cost of a year's travel to market if it costs 15 cents a mile to transport the material they carry.

3. Have pupils find the size of all the farms in the school district, and record as follows:

NAME OF FARMER	SIZE OF FARM, ACRES	KIND OF FARMING

Discuss the size of at least two farms as to the type of farming practiced. For example, compare truck farming with general farming.

4. Write a two hundred word essay on the locality, church, school, social organizations, and privileges, and healthfulness of the community.

5. Have pupils copy score card in a permanent notebook.

SCORE CARD FOR FARMS¹

		POINTS
1. Location		
1. Healthfulness of surroundings		5
2. Neighbors		5
3. Schools		5
4. Churches		5
2. Equipment		
1. Size of farms (as adapted to farming)		5
2. Natural advantages (wood, water, drainage)		5
3. Improvements		
1. Ditches, tile drains, buildings		5
2. Site of farmstead		5
3. Shape and size of fields		5
3. Production		
1. Soil, natural fertility		10
2. Condition (freedom from stones, stumps, weeds, and waste land)		10
3. Topography (as affecting erosion, and ease of cultivation)		10
4. Climate (annual rainfall, temperature, frosts)		5
4. Transportation and markets		
1. Wagon roads (kind and condition)		5
2. Local markets (kind, and distance)		10
3. Shipping facilities		5
Total		100

¹ Boss; "Farm Management."

CHAPTER XXI

PLANNING THE FARM

Plan of farm must insure efficiency. — Farms should be so planned that man labor and horse labor, machinery, land, and fencing may be used efficiently. Often farms are so planned that none of the factors essential to success is present. Why not remodel the farm if it can be improved? Very often farms cannot be replanned to advantage, yet it is also true that many farms can be replanned.

The following general principles should be observed in the management and replanning of a farm :

1. It should provide for a rotation of crops.
2. It should provide for a diversified crop system and an even distribution of farm labor.
3. It should be so arranged if possible that all fields are long and rectangular.
4. It should be so planned that all fields are accessible to the homestead.
5. It should be so planned and so farmed that the fertility of the soil is protected.
6. It should be so planned that the crops grown will provide a balanced ration for all farm animals.
7. It should be so planned that it provides five or more sources of income.

The two diagrams that follow show a farm as it was utilized for many years, and as it is now planned and farmed. They

illustrate the essential points in the planning of a farm. This farm as replanned forms the basis of the discussion in this chapter.

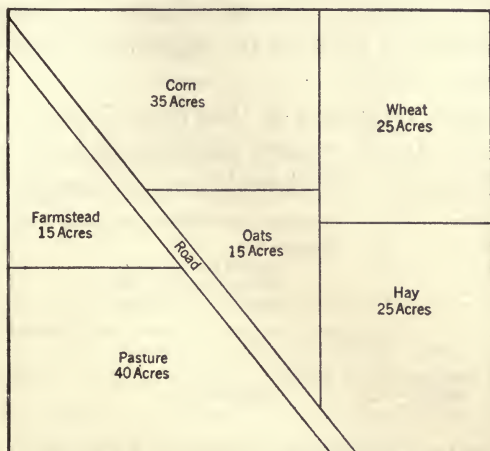


FIG. 160. — A farm of 160 acres poorly planned.

The above farm is poorly planned because (1) the fields are not uniform in size; (2) the roadway cuts diagonally through the farm, making four triangular fields; (3) the house is so located that the fields and pastures are not easily accessible.

The same farm when replanned appears as in Fig. 161.

1. The farm represented in the second plan is farmed according to a strict system of crop rotation. A six-year crop rotation is used. The crop yields are above the average secured in that section, because legumes are systematically used in the crop rotation. They aid in protecting the soil.

2. A well-planned farm must provide for a diversified crop system. Such a system distributes labor, protects the fertility of the soil, provides a ration which is more nearly balanced, and reduces the chances for a complete failure.

3. The improved plan provides for long rectangular fields.

It is well known that long rectangular fields are more easily and more economically cultivated than triangular or irregular fields. Long fields are adapted to the use of larger machinery, and the use of large machinery is one of the efficiency factors in economical production.

4. The farm is replanned so that every field is accessible to the homestead. In the original plan two fields were not accessible to the farmstead. Fields which are inaccessible to the farm-

30 Acres Pasture	30 Acres Corn and soybeans 2 Years Oats and red clover 2 Years Wheat 2 Years
	30 Acres Alfalfa for 6 Years
	30 Acres Wheat 2 Years Corn and soybeans 2 Years Oats and red clover 2 Years
10 Acres Farmstead	30 Acres Oats and red clover 2 Years Wheat 2 Years Corn and soybeans 2 Years

FIG. 161. — A farm of 160 acres well planned.

stead cannot be tilled nor grazed as conveniently as those fields which are accessible. Driving cattle to and from fields which are not connected by a roadway requires both time and trouble. But if all the fields are connected by way of the pasture, then time and trouble are saved.

5. The above farm is so arranged and cropped that the fertility of the soil is protected. The crops suggested in the crop rotation draw upon the soil fertility in the proportions shown in the following table.

DIFFERENT CROPS REMOVE PLANT FOODS IN DIFFERENT PROPORTIONS PER TON

	NITROGEN	PHOSPHORUS	POTASH
	Pounds	Pounds	Pounds
Corn	32.4	13.8	8.0
Wheat	39.6	17.2	10.6
Oats	39.6	16.2	11.2
Blue grass	6.6	1.9	7.1
White clover	7.4	1.8	8.1
Red clover hay	41.0	7.8	32.6
Alfalfa hay	47.6	10.8	44.6
Soybean hay	25.6	6.8	23.3

Thus it may be seen that different crops remove slightly different quantities of plant foods, and since they remove plant foods from different layers of the soil, they protect the soil fertility. The legumes also store considerable quantities of nitrogen in the soil; and the nitrogen content will be almost maintained by the above cropping system. Especially is this true if most of the feeds are fed on the farm. The suggested crops will also leave a large quantity of organic matter on the soil. The stubble and aftermath grown on the hay fields, the mat of fibrous roots of the grasses, and the long tap roots of the legumes will help to maintain the organic matter and the humus supply.

6. The above farm is so planned that the crops grown will provide a balanced ration for all animals. A balanced ration is essential for best results with all farm animals. A balanced ration comprises proper amounts of carbohydrates, fats, protein, and ash nutrients. The feeds produced in the rotation suggested on the above farm will furnish, if compounded properly, well-balanced rations. It will probably be advisable to add a small quantity of bone meal or cottonseed meal in some instances to give best results. The nutritive ratio of feeds required by

most animals is about as 1:5.5. This requirement is closely approached by many of the feeds grown; and if feeds are combined, the proper balance in the ration may be closely approximated, as the following shows:

	DRY MATTER	CRUDE PROTEIN	CARBOHY- DRATES	FAT	NUTRITIVE RATIO
100 pounds	Pounds	Pounds	Pounds	Pounds	
Blue grass $\frac{3}{5}$ or 60% . . .	18.9	1.38	8.8	0.36	
White clover $\frac{2}{5}$ or 40% . . .	8.9	1.24	3.84	0.20	
Total	27.8	2.62	12.64	0.56	1:5.3
Alfalfa hay	91.4	10.6	39.0	0.9	1:3.9
100 pounds					
Corn silage 60%	15.78	0.66	9.0	0.42	
Soybeans 40%	9.68	1.24	4.28	0.20	
Total	25.46	1.90	13.28	0.62	1:7.7
Oats	90.8	8.9	52.1	3.8	1:6.3
Red clover hay	87.1	7.6	39.3	1.8	1:5.7
100 pounds					
Wheat straw	45.8	0.35	17.5	0.25	
Oat straw	44.2	0.50	21.3	0.45	
Total	90.0	0.85	38.8	0.70	1:47.0

Thus it may be seen that a pasture composed of blue grass 60 per cent and white clover 40 per cent provides an excellent ration with a nutritive ratio of 1:5.3. It is also well known that a silage feed consisting of corn silage 60 per cent and soybeans 40 per cent is a fine ration. But since the nutritive ratio is 1:7.7, it requires a nitrogenous supplement. Red clover, with a nutritive ratio of 1:5.7, is a fine ration by itself; yet some concentrates fed along with the other seeds will improve the ration a great deal.

The legumes and grasses grown on this farm also supply the

mineral ingredients in about the right amounts and proportions. A working horse, a fat-producing animal, a growing animal, and a milk-producing animal require a good deal of mineral matter in their feed.

The following table shows the amount of mineral matter per 1000 pounds of various feeds and the bodies of animals.

POUNDS OF MINERAL MATTER IN 1000 POUNDS

	PHOSPHORIC ACID	POTASH	LIME	MAGNESIA
Cattle	15.0	2.0	16.0	0.79
Swine	6.5	1.4	6.3	0.32
Sheep	11.0	1.6	13.0	0.52
Bone of man	36.5	0.32	51.3	1.04
Bone of cattle	37.4	0.18	51.2	1.05
Milk	2.0	1.7	1.7	0.20
Blue grass	5.4	21.0	4.3	3.6
White clover	3.9	16.3	16.0	4.5
Shelled oats	6.8	23.3	17.2	10.3
Red clover	3.9	16.3	16.0	4.5
Alfalfa	5.4	22.3	19.5	5.9
Wheat bran	29.5	16.2	0.9	7.3
Cottonseed meal	26.7	18.1	3.6	8.6

It is well known that 90 per cent of the dry matter in the bone ash is composed of lime and phosphorus. From the above table it may also be observed that the grasses and grass products, such as bran, are very low in lime. The legumes have a high lime content. On the other hand, grasses have a high phosphorus content; while the legumes are somewhat lower. When both legumes and grasses are fed the mineral requirements of animals are fairly well supplied. The one feed supplements the other in animal nutrition; not only in the mineral requirements, but in the nitrogenous and carbonaceous requirements as well. It

is now well known that many animal diseases, such as abortion, contagious abortion, and rickets, and low vitality, which is the cause of many diseases, may be prevented to a large extent by proper feeding.

7. The above farm provides several sources of income. The grain and grass products are the principal sources. Other sources are: (a) the wheat may be sold as a cash crop; (b) about half of the oats may be sold as a cash crop; (c) about one third of the alfalfa may be sold as a cash crop; (d) eggs and poultry to a limited extent may be sold; (e) occasionally a colt may be sold; and (f) some cattle and hogs may be sold.

Farm surveys made in various sections of the United States show that farms having several sources of income produce greater profits than do those farms having only one or two sources of income. Thus in one farm survey, 27 farms having two or three sources of income had a yearly profit of \$287; while 29 farms that had five or more sources of income made a profit of \$702 yearly.

Application: The fundamental principles underlying the plan and operation of the typical farm used as a basis for the discussion in this chapter may be employed in the management of any farm regardless of size. Of course the details of operation may need changes in a great many instances.

Summary. — Farms that are well planned must provide for diversity of crops properly rotated, for proper distribution of labor, for long rectangular fields and pastures which are accessible to the farmstead, for the protection of the fertility of the soil, for several sources of income, for the growing of such crops as will provide a balanced ration for every farm animal. Practically all of the suggestions of the chapter can be applied in the operation of the average farm, with such modifications as local conditions necessitate.

LABORATORY EXERCISES AND HOME PROJECTS

1. Draw a plan of your home farm or some neighbor's farm. Then replan same and state wherein your plan is superior to the original plan.
2. Get from some farmer information regarding the crop rotation practiced on his farm.
3. Get from several farmers their sources of income and the amount received from each source.

CHAPTER XXII

FARM BOOKKEEPING

Reasons for bookkeeping on the farm. — Bookkeeping on the farm has the following advantages :

1. The farmer may know whether he is making or losing, whether his assets are increasing or decreasing.

2. If books are kept, the farmer may know just what each particular line of farming is doing. He knows whether it is increasing or decreasing his profits. Often farmers think that a certain line of farming is profitable when it really is not ; and conversely, often the stock or crops they think are losing money may be the most profitable.

3. Farm bookkeeping makes farming systematic. In this way farm records are as important to the farmer as banking records are to the banker.

4. It will bring larger dividends for the amount of time spent upon it than an equal time spent upon any other farm operation.

What books to keep. — All bookkeeping should be simple. A definite plan should be followed, including the following points :

1. An inventory
2. Accounts of different crops
3. Accounts of different kinds of stock
4. Accounts of the poultry
5. Accounts of the orchard, garden, and pasture

Note to the Teacher: The materials needed to do the Laboratory Exercises and Home Projects suggested at the close of this chapter are :

Forms on which pupils can make an inventory of a farm, farm receipts and expenditures.

Farm inventory. — An inventory taken yearly of the farm stock, poultry, crops, buildings, and machinery is the most important of all the farm records. This farm inventory may be taken at any time of the year. Some farmers take their inventory January first; others may prefer to take theirs in March, April, or May. At the close of the year another inventory should be taken. Values placed upon things in the inventory should be average values. To put the values too high or too low defeats the purpose of an inventory.

SAMPLE FARM INVENTORY — APRIL 1

	NO.	RATE	1922	1923	1924	1925	1926
Land . . .	160 A. 100 A.	\$50.00 52.00	\$8000	\$5200			
Horses . . .	5 4	108.00 112.00	540	448			
Colts . . .							

Continue this method for dairy cattle, sheep, swine, poultry, farm machinery, farm products, corn, wheat, oats, hay, etc. The divisions and topics included in the farm inventory depend on local conditions and individual farmers. Itemizing machinery will depend upon the taste of the individual farmer. Taking the inventory in considerable detail may prove satisfactory in later

years. By the above outline, inventories may be kept for five successive years.

Another type of inventory is the following: ¹

1. Real estate:		
Land (160 acres at \$50.00)	\$8,000.00	
Improvements:		
40 rods tile drain at \$3.00	120.00	
240 rods woven wire fence at 70¢	168.00	\$8,288.00
2. Buildings:		
House	2,000.00	
Barn	1,500.00	
Other buildings	800.00	4,300.00
3. Live stock:		
Four horses at \$175.00	700.00	
Ten cows at \$60.00	600.00	
Six brood sows at \$20.00	120.00	
Twenty sheep at \$8.00	160.00	
Seventy-five hens at 40¢	30.00	1,610.00
4. Implements and tools:		
One plow	12.00	
One grain drill	45.00	
(List each machine on the farm as above.)		
Tools. (List separately all tools valued at \$2.00 or more. Those under \$2.00 may be included in a lump sum as hand tools.)	20.00	77.00
5. Operating capital:		
Check account at bank	72.00	
Cash in pocket	22.50	94.50
6. Feed and supplies:		
300 bushels oats at 30¢	90.00	
Two tons bran at \$22.00	44.00	
Twenty tons of hay at \$7.00	140.00	
Two bushels clover seed at \$9.00	18.00	292.00
		\$14,661.50

Farm receipts. — The income of the farm may be kept in different forms. The following is suggestive for the income from chickens:

¹ Boss; "Farm Management."

The above gives a detailed record for the poultry flock for the year. Receipts for fowls that are sold may be recorded in the above table. If studied with the inventory, it will give a fair notion of the profit from hens.

Records of dairy cows and of the herd may be kept in a similar way, with slight changes. No up-to-date dairyman will handle a herd without keeping each cow's record.

Receipts of other farm products may be recorded in the simplest fashion possible. The following is one way in which such a record may be kept:

DATE	KIND AND AMOUNT SOLD	PRICE	VALUE

In this table all receipts may be summarized for the year, and the total income for the year be found.

Farm expenditures. — To keep an accurate record of farm expenditures is just as important as to keep the farm receipts. Monthly expenditures for groceries, clothing, feed, and implements should be kept. The following form may aid in keeping this record:

[illegible]

If an inventory has been carefully taken, and the yearly income and expenditure are known, the financial standing may be easily figured. If the inventory remained the same, and the total income for the year was \$980 and the expenditure \$590, then the financial gain would be the difference between \$980 and \$590, or \$390. So if the inventory remains the same, the profits or losses may be found by subtracting the expenditures from the receipts. If the inventory increases, the increase may be added to the profits. If it decreases, it should be subtracted from the income.

These simple suggestions in farm bookkeeping will help in putting the farm practices on a better business footing.

Summary. — Farm inventories taken yearly are the most important records a farmer can keep. Good judgment should be exercised in placing estimates on the value of things recorded in the inventory. Farm receipts will show in a general way the profit from various farm operations. Keeping a record of expenditures is also worth while. If the inventory remains the same, the receipts and expenditures will show quickly the financial standing of the farm. This is as important to the farmer as is the bank's standing to the banker.

LABORATORY EXERCISES AND HOME PROJECTS

1. Take an inventory of some farm, according to the plan above suggested. Record the inventory under different headings, as shown in the paragraph on the farm inventory.
2. Keep the income of a farm for a month. Pupil and teacher may devise a plan for keeping the receipts.
3. Have pupils keep in a suitable form the expenditures in their home for one month. Compare receipts and expenditures for the month.
4. From the inventory taken in Exercise 1, figure the per cent of money invested in each part of the farm.

CHAPTER XXIII

FARM LABOR

Economy of farm labor. — It has been estimated that the average farm horse in the Northern States works 3.5 hours a day. The average number of hours worked by the farmers and their hired hands does not exceed 5 hours a day. If it costs 35 cents to keep a horse a day, his labor is worth 10 cents an hour. If man's labor is worth \$1.50 a day, his labor costs 30 cents an hour. If we double the number of hours worked a day on an average, and if labor can be employed profitably, the cost of labor is reduced one-half.

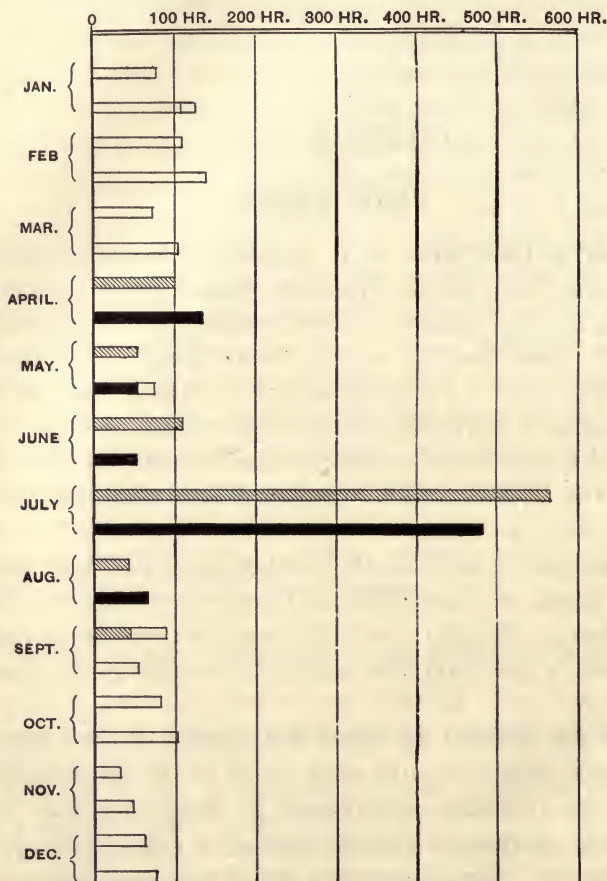
O. R. Johnson ¹ found that the average number of hours worked a day by horses on three different farms was 3.9 hours, and by man 9.9 hours. He also found that men on these farms worked 3272.3 hours a year, and that each horse worked 1216.6 hours a year.

Factors that prevent an equal distribution of farm labor. — The seasonal nature of farm work is one of the greatest factors affecting the constant employment of horse and man labor. Most of the production and harvesting of crops comes in the summer season. Horses and men are both worked hard during the summer months. In winter months men and horses are idle a large part of the time. To illustrate the amount of horse

Note to the Teacher: Follow suggestions at close of chapter.

¹ Missouri Bulletin, No. 36.

and man labor in the production of a timothy hay crop, the following graph is given :¹



GRAPH 7.—Hours of labor given to 67 acres of timothy hay. The upper line in each month represents man labor; the lower, horse labor. The black and the gray lines indicate time given to seeding, haying, etc.; and the white lines, manuring, baling, marketing, etc.

¹ All data for graphs, unless otherwise stated, are taken from Warren's "Farm Management."

Analyzing the above graph, we find that the number of hours of man labor given to the production of 67 acres of timothy hay was 1025, and that more than half of this labor was required during the month of July. The amount of horse labor required to produce the 67 acres of timothy hay was 1125 hours. Almost half of this time (475 hr.) was used in the month of July. If this is the only crop produced, the labor of man and horse is employed about one half of the time. This means unemployment, and that the cost of both man and horse labor is doubled.

The demands for both horse and man labor are greater in the summer months. Practically all the crops need a great deal more attention in summer than during other seasons of the year.

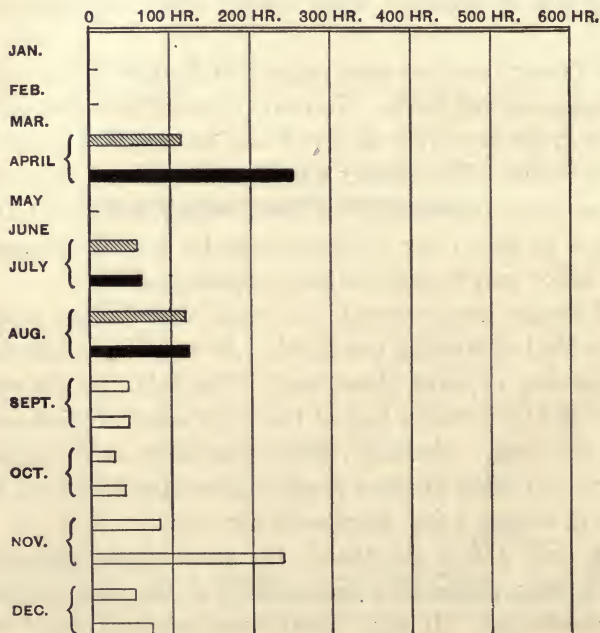
Another factor that prevents equal distribution of farm labor is the unequal sizes of fields. To devote about the same acreage to the same crops from year to year has a tendency to make farm labor more stable. The farmer can plan his labor fairly well if he tends 40 acres respectively of corn, wheat, oats, and alfalfa hay. But if he omits one of these crops for a year, his general scheme of labor may become entirely unbalanced.

A third factor that prevents an equal distribution of farm labor is the kind of farming practiced. As was illustrated above, timothy farming requires about half of the labor in the month of July, or, in other words, half of the work must be done in one twelfth of the year. Similarly, wheat producers, cattle growers, corn raisers, and other farmers producing one product have most of their work during a few months of the year.

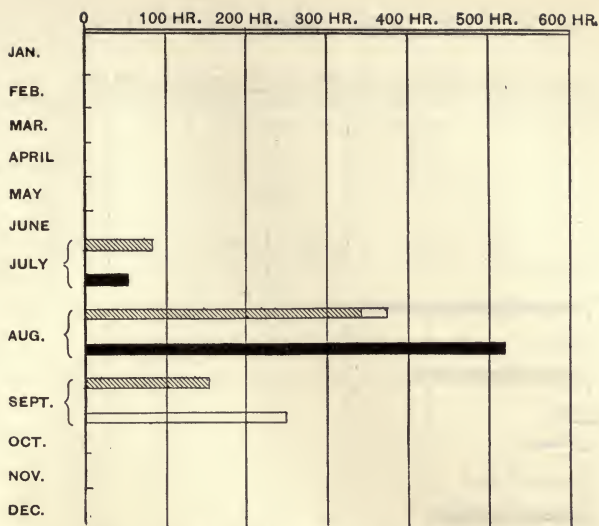
Working only a few months of the year means high-priced labor. If a man works only one twelfth of the time, his labor must be rated high. If 2400 hours constitutes a year's work, worth fifteen cents an hour, his labor is worth \$360, but to pay \$360 for a month's labor of thirty days of ten hours each,

makes the cost of labor \$1.20 an hour. Horse labor may be figured likewise. To feed, stable, and care for a horse for 365 days when he works only a few days, makes the cost of horse labor very high.

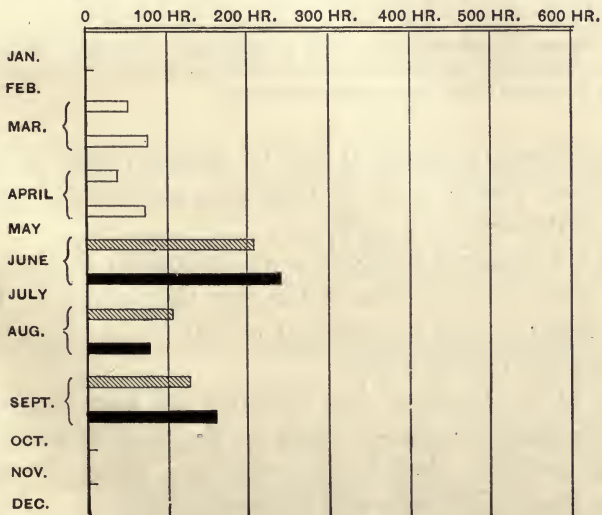
Distribution of labor with different crops. — In the production of oats, April, July, and August are the busy months. Sowing time is in April, and July and August are the months of harvest. The following graphs give an idea of the distribution of horse and man labor in the cultivation of stated amounts of several crops :



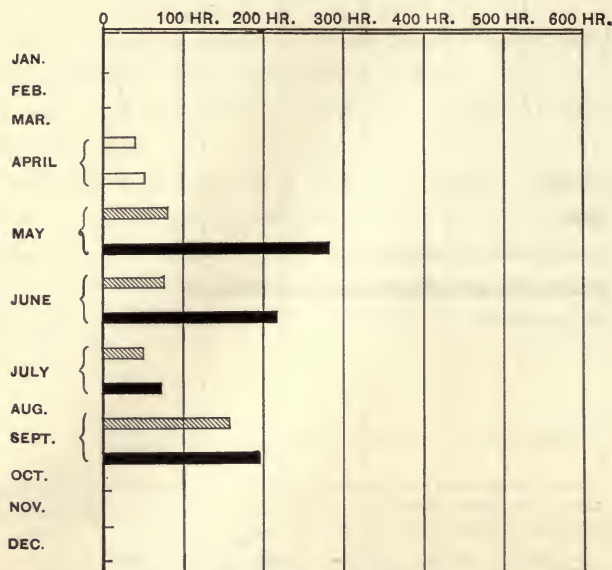
GRAPH 8. — Hours of labor given to 23 acres of oats. The upper line in each month represents man labor; the lower, horse labor. The black and the gray lines represent time given to sowing, harvesting, etc.; the white, to threshing and plowing.



GRAPH 9. — Hours of labor given to 23 acres of wheat. The upper line in each month represents man labor; the lower, horse labor. The black and the gray lines represent time given to harvesting, threshing, etc.; the white line, to plowing, etc.



GRAPH 10. — Hours of labor given to 11 acres of potatoes. The upper line in each month represents man labor; the lower, horse labor; the black and the gray lines, time given to planting, cultivating, digging, etc.; the white, to plowing and marketing.



GRAPH 11. — Hours of labor given to 14 acres of silage corn. The upper line in each month represents man labor; the lower, horse labor; black and gray lines represent planting, cultivating, harvesting; white lines represent plowing.

From the foregoing graphs it will be observed that, in crop production, the greatest part of both man and horse labor is demanded in the summer months.

Farming is a seasonal occupation, an occupation that can be carried on better in one season of the year than another. It is important that the farm be managed so that every season shall have suitable and paying work.

Professor O. R. Johnson¹ has tabulated the man and horse labor requirements of common crops on the basis of hours for each acre production. And for the crops, oats, wheat, timothy, and corn he gives us the following interesting data :

¹ In Bulletin No. 6 of the Agricultural College, Columbia, Missouri.

MAN AND HORSE LABOR REQUIREMENTS OF COMMON CROPS, PER
ACREAGE PRODUCTION

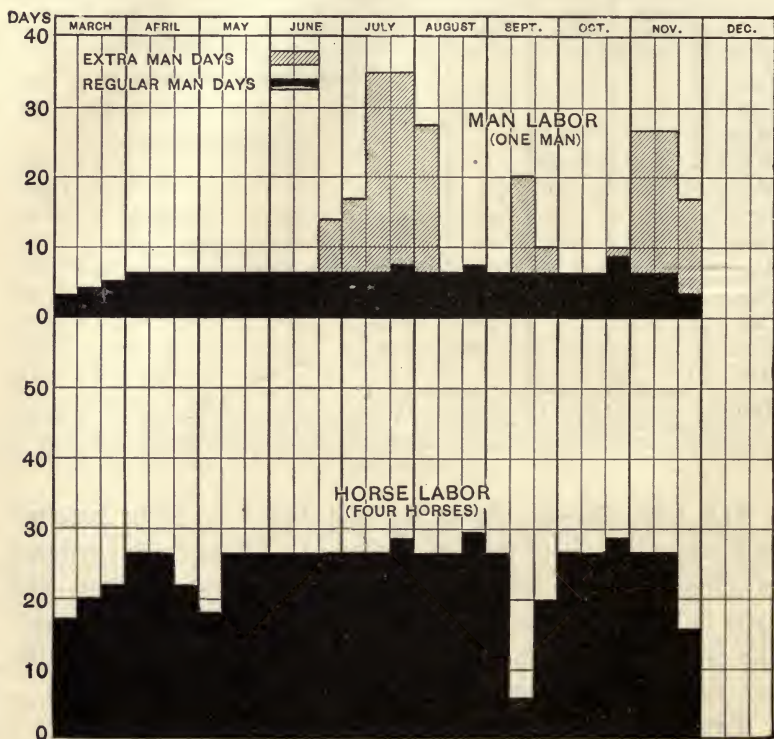
	OATS		WHEAT		TIMOTHY		CORN	
	Man, Hours	Horse, Hours	Man, Hours	Horse, Hours	Man, Hours	Horse, Hours	Man, Hours	Horse, Hours
Jan. .							.55	.28
Feb. .							.48	.10
March	2.92	6.65					.15	
April .	1.32	2.93					1.84	4.57
May .	.26	.79					6.38	14.09
June .	1.11	.87	3.2	3.2	.48	.63	6.72	10.91
July .	3.50	3.69	6.4	6.5	6.02	9.02	2.14	3.25
Aug. .	1.16	1.29	1.62	3.1			1.84	1.17
Sept. .	.17	.21	2.70	5.1			5.03	1.73
Oct. .			4.2	7.3			.78	.72
Nov. .			.26	.5			3.14	1.77
Dec. .							2.55	1.61
Totals	10.44	16.43	18.38	25.7	6.50	9.65	31.60	40.20

This table likewise shows the distribution of labor required to produce an acre of the crop indicated. Of course the amount of horse and man labor will vary with seasons, location, and type of implement used. But it may be concluded that with the production of the above crops neither horse nor man labor can be steadily employed.

Two examples of fairly constant distribution of farm labor. — The first illustration is taken from the 1911 United States Yearbook of Agriculture. It shows the estimated distribution of labor on a 240-acre farm, where 80 acres each of corn, wheat, timothy, and clover hay are grown. (Graph 12.)

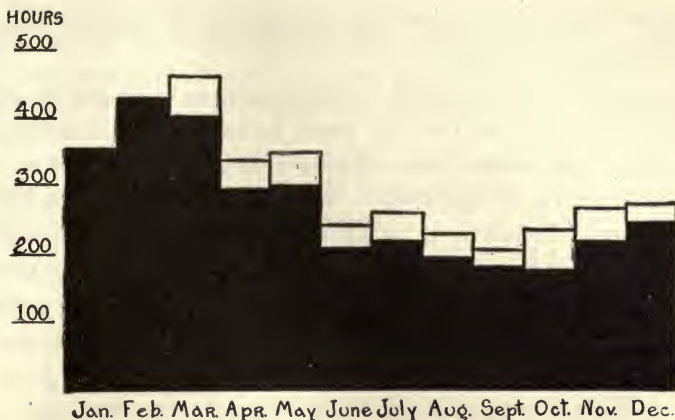
The months are divided into the ten-day periods. One man and four horses did all the work, except a little labor that was

employed in June, July, August, September, and November as indicated. In the farm there were six fields of forty acres each, and the rotation was corn, corn, wheat, wheat, hay, hay. The constant distribution of farm labor will be noted.



GRAPH 12. — Estimated distribution of labor on 80 acres each of corn, wheat, and timothy hay, and of clover hay in the latitude of Missouri. One man and four horses regularly employed. Extra man labor at harvest. Rotation: corn, corn, wheat, wheat, hay, hay.

The second illustration is taken from Warren's "Farm Management." It shows the distribution of man labor on eighteen cows that are being milked, and eleven other cows. (Graph 13.)



GRAPH 13. — Distribution of man labor on 18 cows and 11 other cattle. White is milk hauling.

From this graph it will be observed that dairying furnishes constant employment the year round. The conclusions that are drawn should pertain to farm labor.

Factors helping in the distribution of labor. — The preceding paragraphs illustrate that diversification of farm operations tends to distribute farm labor.

Planning work and keeping a daily schedule of work helps distribute farm labor. A well-planned labor schedule will increase the efficiency of farm work from 5 to 10 per cent. As a rainy-day schedule the following may be suggestive: clean grain, test seed corn and other seed for germination; repair gates, doors, windows; oil machinery, wagons, carriages, and harnesses; paint interior of buildings, hayracks; sharpen tools and implements; clean and whitewash poultry houses; prepare feeds; bring farm accounts up to date; and read agricultural papers and books.

The planning of work to cover an entire year is one of the greatest aids in the distribution of farm labor. With a well-

planned "labor schedule" the congestion of certain seasons may be largely avoided.

A man who plans his work well does not have to get his plow sharpened or fixed on the day when he can plow. The binder, cultivator, and other tools will be ready for work when the right time arrives to use them. Seed corn will have been tested several weeks before it is to be used. Overhauling, repairing, and other work may be done at odd times and will not interfere with the work of planting, harvesting, and cultivating important crops. Preparing bins and granaries will precede their use a week or two. A work schedule will economize labor. Johnson says: "With a well-planned labor schedule the manager will never send the men to cut brush along the fence rows when the binder must be overhauled for wheat cutting to-morrow, or the day after, or the granaries made ready for threshing. When planting time begins, the first day or two of good weather will not be wasted in getting seed cleaned or getting the machinery in running order."¹

Summary. — Farm labor is often not well distributed. The fact that men and horses work so few hours during the year increases the cost of their labor, but decreases the opportunities of the farmer to do a great amount of work. Most farm crops demand the labor devoted to them in the summer season. Dairying and diversified farming tend to distribute farm labor, and give constant employment — two desirable points in farm management.

LABORATORY EXERCISES AND HOME PROJECTS

1. Have pupils bring a statement of the actual number of hours a farmer worked for one week. If his labor is worth \$360 a year, what is the value of his labor an hour according to the answer to the first sentence of this exercise?

¹ Bulletin No. 6, Missouri Station.

2. Pupils are to secure from some farmer an estimate of the number of days (reduced to hours) of both horse and man labor necessary to produce some crop per acre which he plans to raise the following year. The distribution of labor should be graphed by the pupils according to its distribution by months.

3. If man labor is worth 18 cents an hour, and horse labor is worth 9 cents an hour, what is the cost of producing an acre of oats, of wheat, and of corn, according to Johnson's data?

4. Name six or eight things that may be done during a rainy day.

5. If there is a dairy farm in the neighborhood, have the proprietor estimate by months the number of hours of man and horse labor required to care for it a year. The results should be illustrated by a graph.

CHAPTER XXIV

EFFICIENT MARKETING OF FARM PRODUCTS

Agriculture more than production. — Efficient and economic production will always be fundamental in farm operations. Efficient and economic production is hampered by adverse weather and insect pests. It is seldom that the farmer gets more than a half crop. Yet in spite of this fact, poor conditions for distribution discourage the farmer more in his work than do adverse conditions in production.

A few suggestions will be given on efficient marketing of farm products. These suggestions are only general, for each locality, according to the commodities produced, must finally work out its own problems. There will doubtless be a good many exceptions to the suggestions given, for marketing of farm products is probably the most complex of all problems confronting the farmer. This chapter will deal with the larger principles of marketing, and with the major farm products only.

General conditions affecting the market. — These are many and various, but the more important ones will be discussed in the following paragraphs:

1. Seasonal production interferes with efficient marketing of farm products. If the farmer could store his products and if he had good roads so that he could market them any day of the year, and preferably a major portion in winter, his profits would be greater and the consumer would be better supplied. But very often lack of funds on the part of the farmer compels him to sell his product as soon as produced. Moreover, perishable products,

such as vegetables, melons, and some fruits, must be sold during the season when produced. If marketing is to be most efficient, the product marketed must be of good quality, and one fifty-second of the product must be well distributed weekly.

When do farmers sell their products? They sell the major part of their products when they are produced and harvested. The following table from the *Crop Reporter* of the United States Department of Agriculture shows this to be true.

WHEN FARMERS SELL THEIR CROPS, EXPRESSED IN PERCENTAGES. TABLE
SHOWS SIX-YEAR AVERAGES

	WHEAT	CORN	OATS	COTTON	POTATOES	EGGS	LIVE STOCK
Jan. .	6.1	13.8	7.0	9.0	4.0	3.3	10.3
Feb. .	5.3	10.8	6.7	5.9	4.0	4.7	8.1
March .	4.0	6.7	5.0	5.2	6.4	12.8	9.2
April .	3.6	5.1	4.2	3.7	6.5	16.8	8.2
May .	3.9	6.8	5.7	2.2	4.9	15.3	6.2
June .	3.7	6.3	5.9	1.6	3.9	11.9	7.4
July .	12.4	4.7	8.0	1.1	6.1	8.7	5.3
Aug. .	13.5	6.1	17.1	1.2	8.7	7.6	5.5
Sept. .	15.5	6.1	13.3	14.1	14.1	6.4	8.7
Oct. .	13.8	6.3	11.3	21.8	24.5	5.3	11.8
Nov. .	10.0	11.4	7.7	19.8	11.6	3.9	9.8
Dec. .	8.2	15.0	8.1	14.4	5.3	3.3	9.5
Total .	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The table shows that about 52 per cent of the wheat crop is sold in four months' time; that 41 per cent of the oat crop is sold in three months' time; that over 40 per cent of the cotton crop is sold in two months' time; and that 57 per cent of the egg crop is sold in four months' time. What effect does this have upon the supply? It means that at certain times of the year the market is oversupplied and that at other times the demand exceeds the supply.

What effect does this have upon the price? Definite answers cannot be given to the question. But it is evident that market-

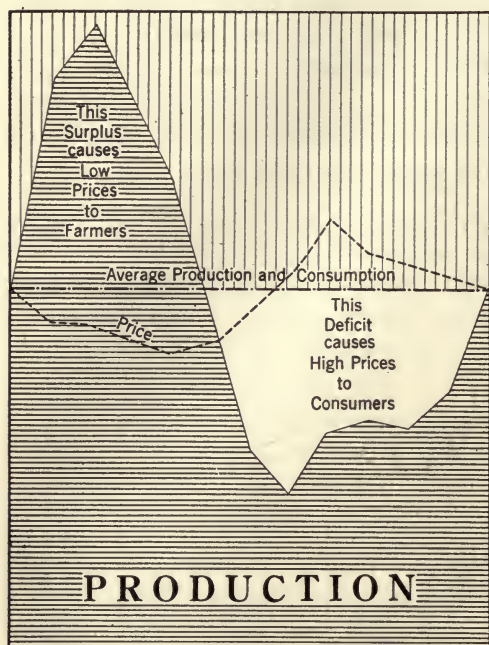


FIG. 162. — Can the peaks and valleys in prices which are alike injurious to consumer and producer, be reduced by more effective marketing methods? On the solution of this problem depends the future of American agriculture.

ing 50 per cent of a product in four months' time is bound to lower the price, and then, when the supply decreases, the price is certain to increase, provided all other things are equal.

2. Prices which the farmer receives exhibit a large geographic variation. Thus the following map shows a variation of price on corn, ranging all the way from 45 cents to one dollar a bushel.

We can hardly conceive that corn would sell at 45 cents at one place and at one

dollar at another. Suppose hogs should sell on a similar basis. Thus they might be \$4.50 at one place and \$10 at another. Suppose the Ford car should sell for \$450 at one place and \$1000 at another. It is absurd to think this. Corn has been taken in this illustration. Similar comparisons could be made with practically all other farm products, so far as prices are concerned.

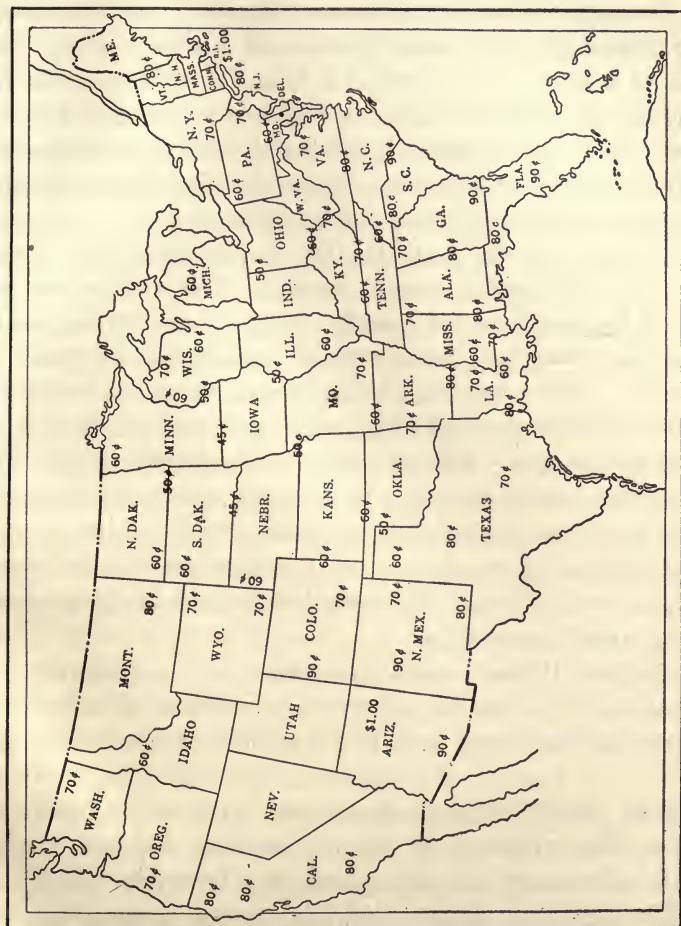


FIG. 163. — Geographic variations in the price of corn. Many farm products show similar variations.

How may the variation of prices be made more equal? By marketing and distributing the article evenly and uniformly throughout the year, and by shipping to those localities where prices are higher, provided the freight rate to get the article there is no more expensive.

3. The production in foreign countries affects market values. If, for illustration, the wheat harvest of Russia, Canada, and Argentina is above the average, it is bound to reflect itself in the markets of the United States. It will lessen our annual export of about 200,000,000 bushels; and when this is left on the markets of our country it is evident, if all other farm crops are up to normal in quantity, that wheat prices will go down.

4. There is a world market. The world market is a broad market and therefore a reliable market. The world market is governed by supply and demand. To-day commodities can be directed by cablegrams or by wireless messages to any place in the world. Almost any day in the year there are 30 million to 80 million bushels of wheat afloat, which can be directed by cable or wireless messages. This stabilizes the world price level. The farmer often cannot reconcile local prices with world markets, and for that reason farmers should study world-wide production as well as local, state, and national production, for the world-wide price levels over which no one has control should be a part of every farmer's knowledge.

Speculation thrives under uncertainty. Concentration of information in the hands of a few persons and lack of information on the part of the masses leads to the wildest schemes of speculation.

Farmers should acquaint themselves with world conditions regarding their products, by reading the *Crop Reporter*, United States Yearbooks of Agriculture, and good farm papers.

5. The full employment of all labor, other than farm labor, makes a better buying public. Unemployment leads to poverty, and markets depend upon a steady money income of all the laboring classes.

Factors helpful in efficient marketing. — Some of the factors helpful in efficient marketing are: (1) storage; (2) facilities for

transportation; (3) uniformity of product; (4) quality of product; (5) meeting the demands of the market; and (6) coöperative marketing.

1. Storing and the preservation of things marks a certain degree of civilization. Uncivilized people store, save, and preserve very little for a future day. But from time immemorial progressive people have stored and preserved their food, clothing, and wealth for future use. The year of plenty must tide over the lean year. So farm granaries, community elevators, cold storage plants, wool pools, and other methods of storing farm products of the community may now be found all over the United States and other civilized parts of the world.

2. Facilities for transporting agricultural products is a helpful factor in efficient marketing. Good roads that may be used 365 days of the year do much to protect both the producer and the consumer. They protect the producer because he can market his products in the winter, and at any other time when his productive farm work is least interfered with. They protect the consumer because the farmer can distribute the necessities of life when most needed. Efficient railroad service at a reasonable cost is likewise helpful in protecting producer and consumer.

3. Classification and grading of farm products is another factor which helps efficient marketing. If a bushel of potatoes is sold, half of them large, nice potatoes, and the other half small and scabby, it is evident that the price will be below what it should be ordinarily. Again, if a dozen eggs are sold, half of them extra large eggs and the other half small eggs, the price will be materially lowered. Uniform, good quality farm products bring a premium. But inferior, poorly graded products are discounted.

The advantages to the producer of grading products are: (1) it increases the price; (2) it stabilizes and creates a surer

market; (3) it assures greater confidence on the part of the consumer; and (4) it assures many sales at a distance. Unless the products are graded they must be inspected before they will be purchased.

4. Quality at once affects the selling value of farm products. The sugar mule is no better than the lumber mule except in quality and action, and for these two reasons his usefulness is augmented so that a pair of sugar mules will bring \$50 to \$100 more than an equally good pair of lumber mules. Quality in eggs means the best market price, but if they are off in quality, they are decreased in value 20 to 50 per cent. The annual estimated loss on eggs in the United States because of inferior quality is \$45,000,000, and on fowls \$75,000,000. It is thought by some that rotten eggs are the only source of loss to the farmer, but we should remember that lack of quality in any product lowers its selling value. Wheat, oats, hay, and many other products are sold according to weight and quality. If a bushel of wheat weighed 60 pounds, but was moldy because of getting wet, its selling price would be lowered about one third, and in many cases it could not be sold at all except for feeding purposes. Quality in seeds, as shown by absence of foreign seeds, dirt, sticks, or other adulterant, is a powerful factor in enhancing their selling price. Clover seeds with a few foreign seeds often cannot be sold at all. This is a direct loss to the farmer. Wool is often so full of cockle-burs, sticks, weeds, and dirt that its selling price is cut in half or more. The loser in each case is the farmer; and the consumer's wants are not satisfied. From 5 to 15 per cent loss to the average farmer's income is inflicted because he is not careful to add quality to the products he sells.

Everything the farmer sells is immediately classified by the purchaser. The price of eggs throughout the summer is lower than it would be if the merchant knew that all the eggs he pur-

chased were fresh, infertile, and superior in quality. Wool, fruits, grains, and every other product sold is likewise affected. In some products the quality can be seen; in some it cannot be seen. But the market price is easily known and should stimulate farmers to market a better quality of products.

5. Meeting the demands of the market is important in marketing farm products. The wide variation of prices on farm products is often due to the fact that no attention is given to market demands. On the same day prices on hogs vary as much as 2 cents a pound; on cattle 3 cents; and on sheep 4 cents. The degree of finish and the demand of the market cause this variation. Who sustains the loss? The producer sustains most of this loss, although the demands of the consumer are probably not met.

6. Coöperative marketing helps probably more than any other single factor in the proper distribution of farm products. A proper distribution helps to maintain a more uniform and a higher price than spasmodic marketing or dumping products upon the market in a small area. There are plenty of farm products produced in the United States, but they are not well and uniformly distributed to every person in the United States. This is a complex problem and the solving of it deserves the best effort and intellect of the farmers and people of the entire country.

Summary. — Efficient marketing of farm products is essential to both producer and consumer. Some difficulties, such as poor roads and other poor facilities for marketing, geographical variation of prices, production in other parts of the world, and seasonal production and distribution, interfere with efficient marketing. On the other hand factors that aid efficient marketing are: (1) storage; (2) better facilities for transportation; (3) classifying and grading the product; (4) selling a quality product; (5) meeting the demands of the market; and (6) coöperative

marketing. Marketing and distributing one fifty-second of the entire output of a given commodity weekly throughout the year will do much to accommodate the consumer and bring profit to the producer.

LABORATORY EXERCISES AND HOME PROJECTS

1. Pupils should bring a written report of some coöperative marketing organization of their county or state, giving the following information: (a) when it was organized; (b) how it is organized; (c) how it is governed; (d) what it markets; (e) how it classifies its product and on what basis; and (f) what service it renders to the farmers.

2. State the market classes and grades of (1) corn, (2) wheat, and (3) oats.

3. What are the market classes and grades of eggs?

CHAPTER XXV

CARDINAL POINTS IN MAKING THE FARM PAY

Major factors in profitable farming.—The minor points which are helpful in making the farm successful are: fertile soil, productive plants, good markets, proper equipment, and a co-operative community. While these are helpful it has been found in farm surveys that the major factors essential to success are: (1) size of farm; (2) use of large machinery; (3) efficient use of man labor; (4) crop yields; (5) reasonable diversity; and (6) the farmer himself.

1. *Large Farms.* It is at once evident that the large farm has certain advantages. It can use machinery, also man and horse labor more efficiently. The large farm requires no larger house than does the small farm. Capital is better distributed as shown in the following table:

RELATION OF SIZE OF FARM AND DISTRIBUTION OF CAPITAL

SIZE OF FARMS	PER CENT OF TOTAL CAPITAL INVESTED					
	Land	House	Other Buildings	Live Stock	Machinery	Feed, etc.
40-100 .	70.0	10.0	6.0	8.4	2.5	3.1
101-150 .	76.3	6.3	5.4	7.8	1.8	2.4
151-200 .	80.3	4.3	3.9	6.8	1.9	2.8
201-250 .	81.5	3.4	3.2	7.0	1.7	3.2
251-320 .	82.7	3.2	4.7	6.0	1.3	2.1
Over 320 .	83.5	3.6	2.7	6.2	1.3	1.9

The table shows that the farms ranging from 40 to 100 acres had only 70 per cent of all the capital invested in land, while farms ranging from 151 to 200 acres had over 80 per cent of all their capital invested in land. This is in favor of the large farm because land is productive capital. Farms ranging from 40 to 100 acres had 16 per cent of their capital invested in buildings, while the farms ranging from 151 to 200 acres had only 8 per cent so invested. This is in favor of the large farm because buildings are not productive capital. There is always a higher proportion of money invested in machinery on the small farm than on a large farm; and the machinery on a small farm cannot be used for as many days, nor as efficiently as it can be used on the larger farm.

2. *Large farms use machinery more efficiently.* The American farmer produces at least four times as much as the European farmer. The European farmer works harder, and every member of the family works in the field with shovel, hoe, and rake. The American farmer, in contrast to the European farmer, drives three to five big horses and uses implements to correspond to the number and size of horses used.

As a basis for comparing the relative efficiency of machinery on large and small farms the following, taken from the Census Report, deserves close study.

MACHINERY ON LARGE AND ON SMALL FARMS IN THE ENTIRE UNITED STATES

ACRES FARMED	VALUE OF MACHINERY	INVESTMENT IN MACHINERY PER ACRE
Under 3 acres	\$ 53	\$31.18
3- 9 acres	42	7.50
50-100 acres	106	2.16
175-259 acres	211	1.64

Small farms usually have a high per cent of money invested in machinery, and still they are not adequately equipped with machinery. Furthermore, machinery on large farms is used on a much larger acreage.

The following table shows how the improvement of machinery has increased the economical production of crops.

COST OF PRODUCTION BY HAND AND BY MACHINE PER ACRE

	YEARS OF PRODUCTION		COST		PER CENT
	Hand	Machine	Hand	Machine	Decrease
Corn, 40 bushels 1 acre	1855	1894	\$16.34	\$6.62	59
Wheat, 20 bushels 1 acre	1829-1830	1895-1896	4.00	1.12	71
Oats, 40 bushels 1 acre	1830	1893	3.85	1.60	58
Hay, 1 ton 1 acre	1850	1895	1.92	0.63	67
Cotton, 750 pounds 1 acre	1814	1895	6.15	4.71	23
Potatoes, 220 bushels 1 acre	1866	1895	13.18	5.97	54

The small farm has much more hand labor than the large farm. This in some instances means a doubling of the cost of production, and consequently more difficult competition for the small farmer.

3. *On large farms man labor is used more efficiently.* A man can do much more work on a large farm and do it more easily than on a small farm. The following table shows the relative efficiency of man labor on large and small farms, and it deserves careful study.

MAN LABOR MORE EFFICIENT ON LARGE FARMS
(Nebraska Bulletin No. 157)

AREA OF FARMS ACRES	AVERAGE LABOR INCOME PER FARM	AVERAGE NUMBER OF MEN PER FARM	AVERAGE NUMBER OF ACRES PER MAN	PRODUCTIVE ANIMAL UNITS PER MAN
40-100	\$122	1.11	58.5	6.7
101-150	355	1.14	90.0	9.5
151-200	322	1.38	101.9	10.9
201-250	684	1.90	101.2	13.5
251-320	445	2.14	114.0	11.9
Over 320	324	2.61	113.5	16.6

On farms ranging from 40 to 100 acres, the average number of acres tilled per man was 58.5; but on farms containing over 320 acres one man tilled 113.5 acres or almost twice as much.

It has been said that the production per acre on the small farms is two or three times as great as it is on the large farms. The following data taken from extensive surveys will indicate that large farms produce as much per acre as do small farms.

ACRE CROP YIELDS ON 75 DAIRY FARMS
(New Jersey Bulletin No. 321)

AREA OF FARMS	POTATOES	CORN	WHEAT	RYE	HAY	CROP ACRES PER ANIMAL UNIT
Acres	Barrels	Bushels	Bushels	Bushels	Tons	
50 or less	44.5	45.1	13.2	12.3	1.3	1.8
51 to 100	57.9	44.6	20.1	17.5	1.4	3.1
101 and over	59.6	41.9	19.7	15.9	1.3	3.9

The bulletin giving these figures states: "Farms of 50 acres or less are not producing so good yields as those of 51 to 100 acres, while the yields on those with 101 or more acres are not quite so good, with the exception of potatoes. For these dairy farms it

appears that medium-sized farms yield a little better crop per acre than farms larger or smaller. At any rate, the small farms are not the best yielders. The difference between the large and the medium-sized farms is not great."

4. *Crop yields.* This general statement may be made: Those farmers who produce larger crops are the most prosperous farmers. Men on small farms often spend too much an acre to secure profitable returns. Large crop yields should be produced as economically as possible. Large fields, large machinery, the economic use of motive power, and a fertile soil are the principal factors in economic crop production.

It costs little more to produce 60 bushels an acre than it does to produce 30 bushels. But the cost to produce a bushel of produce depends almost directly on the yield for the acre, provided all other things are the same. Thus, to produce 30 bushels of corn an acre may cost at the rate of \$1 a bushel; but if 60 bushels an acre are produced, the cost to produce a bushel is about fifty cents.

Andrew Boss states (*Hoard's Dairyman*, 1919): "The cost of growing large crops is very little more than that of growing an average or a lower than average crop. Consequently any increase in yields over the average is almost clear profit."

Now let us get to the specific question: What do farm surveys indicate regarding crop yields for the acre in relation to farm profits? A survey made of 668 farms by the Missouri Station (Bulletin No. 140) showed the relationship between crop yields and labor income.

The table on page 380 shows that those farms having a crop index of 110.4 had a labor income of \$999; but those farms having a crop index of 92.3 had a labor income of only \$227.

5. *Diversity of enterprise.* The old saying, "It is not wise to put all the eggs in one basket," applies to farming in general;

CROP YIELDS AND LABOR INCOME

AREA OF FARM IN ACRES	AVERAGE SIZE OF FARM IN ACRES	NUMBER OF FARMS	CROP INDEX ¹	LABOR INCOME
40 or less	26.6	47	100.7	\$146
41 to 80	64.7	149	92.3	227
81 to 120	103.3	151	93.9	313
121 to 200	159.2	191	101.2	525
201 to 400	243.5	106	102.5	711
Over 400	459.6	24	110.4	999

for the farmer who carries on diversified farming, rather than devoting all his energies to one thing, invariably succeeds best.

The Michigan Station in a recent survey of 450 farms furnishes some interesting facts on what to grow and how much. According to this survey the most profitable farms have 30 to 50 per cent in wheat, 1 to 10 per cent in barley, and 20 to 30 per cent in hay.

Surveys show that farmers having 6 or 7 sources of income have a greater labor income than do those farmers having only one or two sources of income. The following table illustrates this. (United States Yearbook of Agriculture, 1913.)

DIVERSIFICATION INCREASES CHANCES FOR A LARGER INCOME

NUMBER OF YEARS	DIVERSITY INDEX	AVERAGE ACREAGE	LABOR INCOME
27	2 to 3	93	\$287
46	3 to 4	94	418
32	4 to 5	97	436
29	Over 5	93	702

¹ Crop index is based upon the average yield per acre. Thus a crop index of 92.3 means that the yield per acre on that farm is 92.3 per cent of the average yield of the crops of that region.

Twenty-seven farms having 2 to 3 sources of income had a labor income of \$287; but 29 other farms of the same size having over 5 sources of income returned \$702 as a labor income.

Briefly stated the advantages of diversification are as follows: (1) It enables the farmer to make more efficient use of man and horse labor; it distributes labor. (2) It causes the farmer to follow a systematized scheme of crop rotation which causes larger yields, and produces feeds which are more nearly balanced.

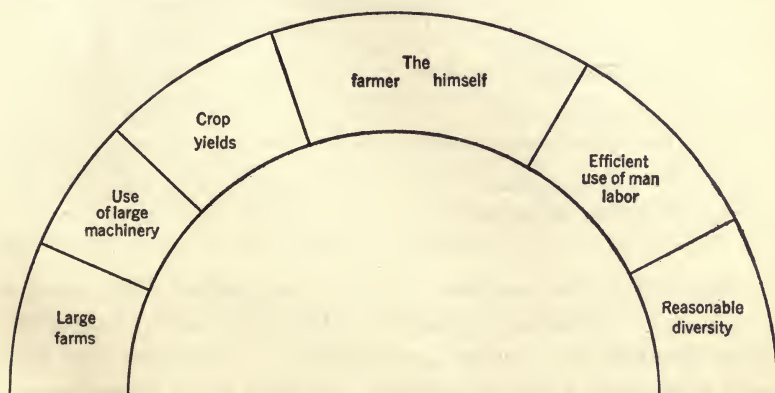


FIG. 164. — Some essential factors which are helpful in making the farm pay.

(3) It enables the farmer to utilize all cheap feeds produced on the farm, such as pasture and straw. (4) It diminishes risks and increases the chances to make money.

6. *The farmer himself as a factor in successful farming.* Industry, thrift, economy, business ability, and judgment to do the right thing at the right time and in the right way are all very important factors in making the farm a success. Some men could be given a farm of the right size, started with the proper amount of capital, shown how to diversify crops, be provided with the best and most suitable machinery, and yet fail, because they lack the necessary personal qualities.

All other things being the same, surveys show that an education pays on a farm as well as in other places of business. We quote the following data on the worth of an education to the dairyman. (Missouri Station Bulletin No. 140.)

EDUCATION OF FARMER AND LABOR INCOME

SIZE OF FARM	EDUCATION	NUMBER OF FARMERS	AVERAGE SIZE	AVERAGE CAPITAL	LABOR INCOME
Acres 41 to 80	District school	143	65.5	\$5,475	\$215
	More than district school	12	65.5	7,774	317
121 to 200	District school	140	157.2	12,768	490
	More than district school	38	160.0	13,273	554
201 to 400	District school	77	266.6	21,464	677
	More than district school	25	261.8	22,174	1,176

The table shows conclusively that the education of the operator of a farm is a factor in profitable farming; for in every case where large numbers of farmers are included in a survey, the man with more than a common school education has a larger income than has the man who has only a common or district school education.

Summary. — There are many factors that make for success in farming. The most important factors are: (1) size of the farm; larger farms being more profitable than small ones; (2) use of large machinery; (3) efficient use of man labor; (4) crop yields; farmers having large crop yields usually have the largest labor income; (5) diversity of enterprise: since several sources of income insure a greater and surer profit; and (6) the farmer himself; industry, thrift, economy, judgment, and an education are qualities which make for the successful operation of a farm.

LABORATORY EXERCISES AND HOME PROJECTS

1. Visit some successful farms, and determine what factors make them a success and why. Record your findings.
2. Bring to class a short discussion on how the machinery is used on some farm, other than the one visited by the class.

TWENTY QUESTIONS FOR DEBATE

1. *Resolved*, That hired men on farms should receive the same pay for the same hours that men receive in factories.
2. *Resolved*, That the educational opportunities of children in the country should be equal to those enjoyed by the boys and girls in town.
3. *Resolved*, That orcharding is more profitable than dairying.
4. *Resolved*, That live-stock farming has more advantages than grain farming.
5. *Resolved*, That the daylight-saving law is to the best interest of the people of the United States.
6. *Resolved*, That it would be to the best interest of the farmers for the Government to own and operate the railroads.
7. *Resolved*, That the present number of middlemen is to the best interest of the farmers of the United States.
8. *Resolved*, That corn clubs are more important and valuable than are sewing and cooking clubs.
9. *Resolved*, That coöperation is of greater value to the farmer than competition.
10. *Resolved*, That the dairy cow is more valuable than any other farm animal.
11. *Resolved*, That agriculture should be the center and core of the course of study.
12. *Resolved*, That the Jersey cow is more beneficial than all other dairy breeds combined.
13. *Resolved*, That farmers should market one fifty-second of their products weekly.
14. *Resolved*, That McCormick rendered more service to mankind than has Edison.
15. *Resolved*, That the National Government should fix the price of farm products and guarantee to the farmer cost of production, plus a reasonable profit.
16. *Resolved*, That it is fair and just to the farmer and manufacturer and middleman for each to receive one third of the money which the consumer pays for products purchased.
17. *Resolved*, That it is to the best interest of the farmer to prohibit foreign immigration to the United States.

18. *Resolved*, That wood is a more valuable building material than all other building materials combined.

19. *Resolved*, That every school should have at least the following three community gatherings, — (1) a Thanksgiving program, (2) a parent teachers meeting, and (3) a school fair.

20. *Resolved*, That efficient farmers should receive money enough for their farm products to enjoy the same or equal conveniences enjoyed by city people.

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